

# SCIENCE

5 August 1960

Vol. 132, No. 3423

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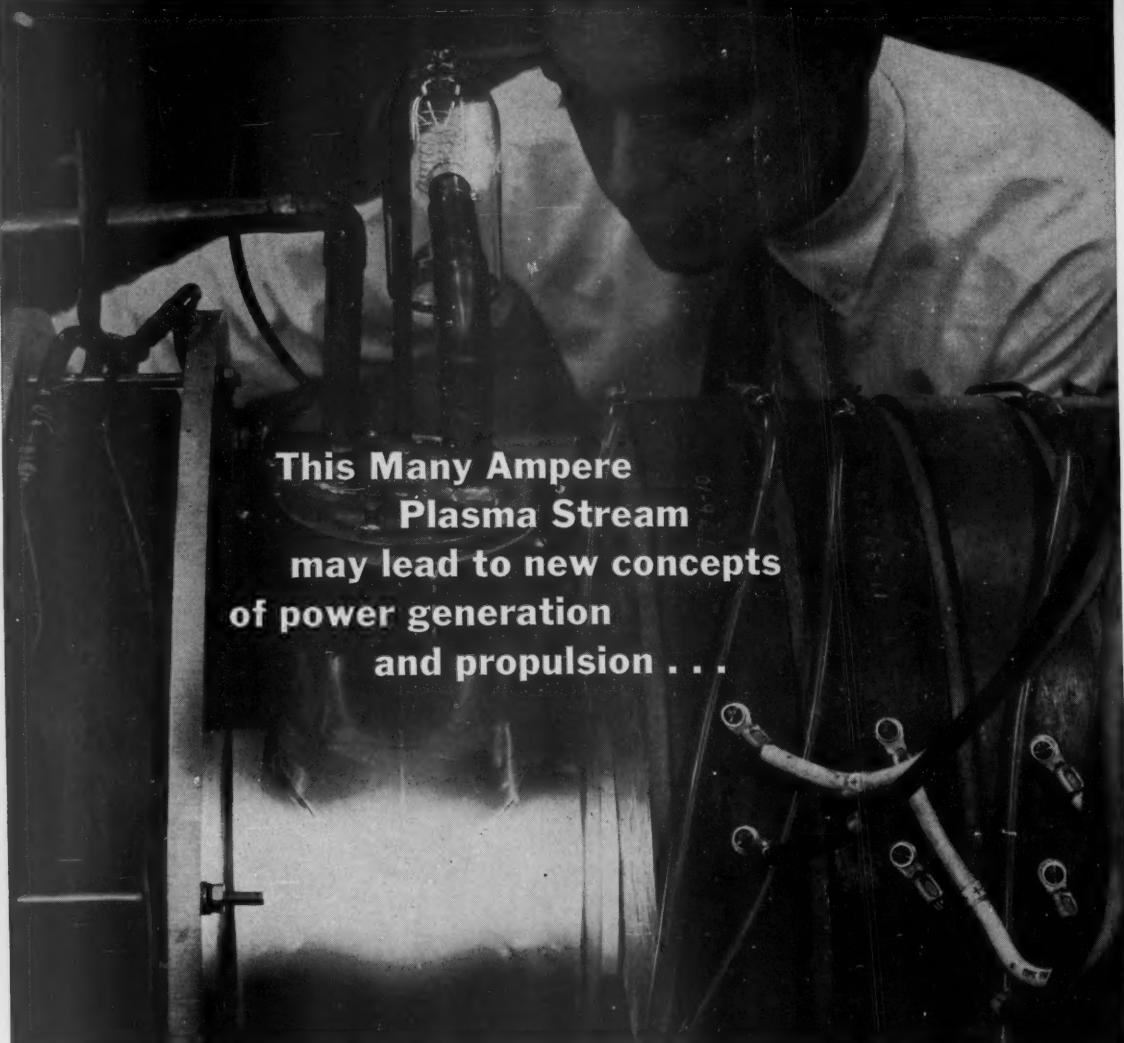
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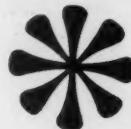
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SCIENCE, which is now combined with THE SCIENTIFIC MONTHLY, is published each Friday by the American Association for the Advancement of Science at National Publishing Company, Washington, D.C. The joint journal is published in the SCIENCE format. SCIENCE is indexed in the *Reader's Guide to Periodical Literature*.

**Editorial and personnel-placement correspondence** should be addressed to SCIENCE, 1515 Massachusetts Ave., NW, Washington 5, D.C. Manuscripts should be typed with double spacing and submitted in duplicate. The AAAS assumes no responsibility for the safety of manuscripts or for the opinions expressed by contributors. For detailed suggestions on the preparation of manuscripts and illustrations, see *Science* 125, 16 (4 Jan. 1957).

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## Dreams and Visions

What is to be the future of science? Extrapolation of history is impossible, perhaps in principle, certainly in practice. The equations of the present allow three possible types of solution for the future. Decline and catastrophe have been predicted on one ground or another, in spite of science, by overpopulation and starvation, or, through the agency of science, by wholesale destruction in nuclear warfare. Continued and accelerated progress have been confidently foretold, the curve sweeping upward faster and faster as each advance in knowledge multiplies the possibilities of further discovery, and as man more consciously assumes control of his own further evolution. Between lies the third and less spectacular solution, that the curve will level out or gently undulate. But the equations are insoluble, at least by any means we know. The uncertainty afflicts and inhibits some people, but their timidity is hardly justified or useful. There has seldom if ever in the world's history been a time when existence was not in some degree precarious, yet the right response to danger lies in action. Faith in the future has indeed a very great survival value. The better equipped are certainly more likely to survive than the worse equipped, and not only to save themselves but to save others.

The task of the men of science is therefore clear. It is to go ahead undeterred by any of the uncertainties. Faith in science is not incompatible with or exclusive of any other kind of faith. Indeed there would seem to be no inconsistency in believing that scientific knowledge is itself one of the great instruments of higher ends. However that may be, duty, expediency, and the zest of living unite their voices in calling for unremitting effort, not in the certainty but in the hope and faith that knowledge may advance, mastery over environment increase, drudgery be abolished, sickness healed, the people fed and life made happier. If social and moral problems are raised they are not essentially new but part of an age-old drama, and should neither be allowed to cause despondency nor to justify obstruction or abstention. The ancient choice between good and evil is in principle unchanged by the scale or fulness of existence. Men have always had to struggle with their environment, with one another and with themselves. Not exemption from danger, hostility or temptation but the power to sustain their impact has made men what they are. The great weapons have been the things of the mind, and among the greatest of these is knowledge. While the old men dream dreams and the young men see visions we should go forward undeterred, that the dreams may become reality and the visions be fulfilled.—CYRIL HINSHELWOOD

[Excerpt from the tercentenary address presented at the formal opening ceremony of the tercentenary celebrations of the Royal Society, London, 19 July, by Sir Cyril Hinshelwood, president of the society.]

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## Shark Attacks during 1959

The conditions under which sharks attack man suggest what measures may be taken to reduce risk.

Perry W. Gilbert, Leonard P. Schultz, Stewart Springer

During the calendar year 1959 the Shark Research Panel of the American Institute of Biological Sciences (1) initiated several projects (2), one of which was the establishment of a comprehensive and permanent "Shark Attack File" for the world, sponsored by the Biology Branch of the Office of Naval Research and the Smithsonian Institution. At present the panel receives news clippings from five different clipping services concerning shark incidents. When a shark attack occurs anywhere in the world, a physician or scientist (3) in the area is immediately contacted and his assistance in securing documentation on the attack is solicited. A two-page form requesting information concerning the location of the attack, environmental conditions, the kind of shark, the nature and treatment of wounds, the type of activity the victim was engaged in at the time of the attack, and so forth, has been prepared for the convenience of those who collaborate in supplying documentation. From reliable documentation of this type the panel members hope to learn more about the environmental conditions and the behavior patterns and activities of swimmers which provoke

a shark to attack. The Shark Attack File, suitably cross-indexed, is under the direction of Leonard P. Schultz and is housed in the Division of Fishes, Smithsonian Institution, Washington, D.C. A duplicate working file is maintained by the chairman of the Shark Research Panel, Perry W. Gilbert, at Cornell University, Ithaca, N.Y.

### Shark Attacks in 1959

Table 1 (4) reveals that during 1959 sharks were indeed active, for there were 36 unprovoked and three provoked attacks on man, of which approximately one-third were fatal.

In addition to the unprovoked shark attacks, we have set up in the Smithsonian file four other categories, as follows: (i) Provoked shark attacks. There were three instances during 1959 in which a shark was caught, trapped, speared, injured, or in some way provoked and subsequently made physical contact with the victim or the gear the victim was wearing. There was no fatality. (ii) Doubtful shark attacks. This category includes the 11 instances in 1959 in which unprovoked sharks approached swimmers but failed to make physical contact with them; it also includes those cases reported as shark attacks which subsequent investigation tends to discredit or place in some doubt. (iii) Air and sea dis-

asters. There were five instances during 1959 in which unprovoked sharks mutilated victims of such disasters; often there is no way of knowing whether the victims died before the sharks attacked or died as a result of the attacks. A total of 302 persons were involved, with only 80 survivors. (iv) Boat attacks. There were 12 instances during 1959 in which unprovoked sharks made physical contact with a boat, life raft, water ski, or accessory equipment. There was no fatality.

During 1959 only two of the 36 unprovoked attacks occurred in water colder than 70°F. This tends to substantiate V. M. Coppleson's belief that a close and measurable relationship exists between sea temperatures and shark attacks and that attacks generally occur in waters warmer than 70°F. It might also be pointed out that bathers and skin divers generally frequent waters warmer than 70°F in greater numbers and that a relationship probably exists between attack incidence and numbers of bathers and skin divers in the water at a given time. The fact that twice as many people were attacked by sharks after 1:00 P.M. as during the morning hours is also a reflection of the increase in the number of swimmers.

Swimming or diving alone, even in familiar waters, has long been discouraged by those who prepare safety rules for swimmers and SCUBA divers. The wisdom of the recommendation "never swim or dive alone" was pointed up during 1959 when five out of a total of 12 bathers attacked by sharks were bathers who were swimming alone or who were a considerable distance from their companions.

It is well established that sharks are frequently attracted to wounded and bleeding fish speared by skin divers. It is also generally agreed that the shark danger zone for a diver is at or near the surface, where movements are less likely to be rhythmic and coordinated. At least three of the nine divers attacked while spear fishing or diving for

Dr. Gilbert is professor of zoology at Cornell University, Ithaca, N.Y. Dr. Schultz is curator in charge of the Division of Fishes at the U.S. National Museum, Smithsonian Institution, Washington, D.C. Mr. Springer is chief of the Branch of Exploratory Fishing of the Division of Industrial Research, U.S. Fish and Wildlife Service, Washington, D.C.

shell fish in 1959 were attacked at the surface, and two of them were towing wounded fish at the time of the attack. Although male victims outnumbered female victims 12 to 1, this does not necessarily mean that sharks exhibit any preference as between men and women but probably should be correlated with the relative frequency with which males enter the domain of sharks.

With but six exceptions, all attacks occurred between latitudes 35°N and 35°S. January was the worst month for shark attacks south of the equator, and August was the worst month in northern latitudes. Thirteen unprovoked attacks, five fatal, occurred in Australian waters and 12 unprovoked attacks, five fatal, took place in U.S. and Mexican waters. South Africa ranked third in 1959 with four attacks, one of which was fatal.

#### Advice to Swimmers or Divers

The recommendations given below are based on numerous reports and publications (5) as well as on information solicited from several experienced skin and SCUBA divers and scientists familiar with the behavior of sharks. For the sake of clarity and brevity, the advice presented is arranged in outline form. It must be remembered above all that sharks are unpredictable. Moreover, we know relatively little about the behavior patterns of sharks and about the environmental conditions which stimulate a shark to attack.

The Shark Research Panel is currently gathering documentation on all shark attacks throughout the world and from an analysis of this documentation hopes to learn more about the conditions which provoke shark attack.

#### Advice to bathers and swimmers.

1) Always swim with a companion. Do not become a lone target for attack by swimming away from the general area occupied by a group of swimmers and bathers.

2) If dangerous sharks are known to be in the area, stay out of the water.

3) Since blood attracts and excites sharks, do not enter or remain in the water with a bleeding wound.

4) Avoid swimming in extremely turbid or dirty water where underwater visibility is very poor.

#### Advice to skin and SCUBA divers.

1) Always dive with a companion.

2) Do not spear, ride, or hang on to the tail of any shark. To provoke a shark, even a small and seemingly harmless one, is to invite possible severe injury.

3) Remove all speared fish from the

Table 1. Data on unprovoked shark attacks during 1959, including all cases in which unprovoked sharks made physical contact with the victim or the gear he was wearing. Cases in which a shark approached but failed to contact the swimmer are not included.

Date	Case No.	Locality	Victim	Age	Kind of shark and length (approx.)	Recovered (R) or fatal (F)	Comments
1/2	404	Lourenço Marques Mozambique	Bay, Sutti, Eric	31		R	In water 16 hr after boat sank; was 200 yd from shore when shark seized and shook him; shouted and hit snout; injuries to stomach and leg.
1/15	402	Melkbai Beach, Cape Town, South Africa	Schreuder, Fanie	18	7 ft	R	Attack in shallow water; injuries to leg and hands.
1/17	383	Safety Cove, Port Arthur, Tasmania	Derry, Brian J.	22	20 ft	F	Naval rating; attacked in deep water about 100 yd from his ship.
1/17	394	Alexandra Headland, north of Brisbane, Australia	Neil, Peter John	18	6 ft	R	Right foot mauled; required 16 stitches; attacked while surfing 200 yd from shore at 9:30 A.M.
1/24	388	Whale Bay, King Island, Tasmania	Grave, John	16		R	Bitten on thigh by shark or large snapper while swimming with motor tube in shallow water.
1/27	408	Galapagos Islands, Ecuador	Swinty, Theodore C.	57	Several, 6 ft or longer	R	Cook on tuna clipper <i>Mary Barbara</i> ; deep bites in right leg and left foot; white plastic helmet knocked off and sharks went after it.
1/31	449	South Perth, Australia	Rudd, George E.	20	Whaler shark, 6 ft	R	Attacked while netting prawns at night; shark grazed legs and followed victim to shore.
2/1	407	Near mouth of Umzimkulu River, Port Shepstone, South Africa	Vermaak, Raymond	14	6 ft	R	Bathing in clear water in deep channel about 20 yd from shore; left leg severed below knee and right leg badly mauled.
2/2	378	Trench's Beach, Honiara, Solomon Islands	Battye, Donald	15		F	Bathing in shallow water with sister; no trace of body.
2/27	387	Margarita Island, Venezuela	Gerbeau, Roland			R	Fell into sea in deep water while attempting to land swordfish; left arm mauled by shark. Lifeboat capsized; victim devoured by sharks.
3/8	450	Mouth of Langoyon River, Davao City, Mindanao Island, Philippines	Sanchez, Leopoldo	20		F	
3/29	393	Marathon, Fla.	McKee, James	13		R	Bathing in murky water between 1 and 2 P.M. with 3 other boys; shark bumped victim and took bite on knee.
4/5	653	Thirroul, New South Wales, Australia	McAuley, Jeff			R	Shark lunged at spear fisherman, taking off half a flipper.
4/11	429	Coconut Island, Torres Strait, Australia-New Guinea	Pearson, James	43	Tiger shark, 6 ft	R	Diving for shells in 3 ft of water; attempted to drive off shark with bare hands; left hand badly lacerated.
5/3	374	Panama City Beach, Fla.	Grover, Ernest	19	10 to 12 ft	R	Spear fishing 0.5 mi from shore at 10 A.M. in black suit, towing 2 lines; water murky; was reloading gun at surface when sharp bit with great force cutting leg, cheeks, and back; forcibly pried jaws of shark loose; 30 stitches required.
5/7	372	Bakers Beach, San Francisco, Calif.	Kogler, Albert	18	Great white shark, 10 ft	F	Bathing 50 yd from shore at 5:30 P.M. with companion; treading water when attacked; entire left shoulder ripped and deep jagged lacerations to back, abdomen, and arms; died 2.5 hr after rescue by Shirley O'Neil.

Date	Case No.	Locality	Victim	Age	Kind of shark and length (approx.)	Recovered (R) or fatal (F)	Comments
6/14	376	Alligator Head, La Jolla, Calif.	Pampierin, Robt. L.	33	20 ft*	F	Diving for abalone with companion in clear water 25 ft deep, 200 ft north of Alligator Rock; pink swim trunks, face plate, flippers; victim rose high out of water with face plate missing and cried for help, then disappeared; companion dived and saw Pamperin's torso protruding from mouth of shark; body never recovered.
6/14	451	San Pedro Nolasco Island, Guaymas, Mexico	Topete, Francisco R.			F	Boat with 4 fishermen capsized 300 yd from island shore; attacked by shark while swimming to shore of island; body never found (?).
7/28	434	Between Alligator Head and Bloomer Beach, La Jolla, Calif.	Fleet, Verne S.	25	Hammerhead shark†, 3 to 6 ft	R	Skin diving in clear water, 30 ft deep, 200 ft from shore; wearing black "wet suit" covering head, torso, and arms; legs bare; had small fish cinched to waist and was reloading spear gun at surface when attacked; shark left 15 tooth marks in left thigh.
8/10	457	Savannah Beach, Savannah, Ga.	Fields, Elizabeth	15		R	Standing in 30 in. of clear water 35 ft from shore; felt shark (?) on foot, kicked it off and ran to shore; 28 stitches needed to close 4 in. wound on outer side of left foot.
8/11	671	Isonoura Sea Shore, Wakayamasi, Japan	Tuchiya, Akira	18	Blue shark	F	Dived off yacht; when 4 m away, shark bit left thigh; victim died from loss of blood.
8/15	439	Gulf of Mexico, off Panama City, Fla.	Neal, Lt. James C.	26		F	Scuba diving 7 to 8 mi offshore in 80 ft of water; followed guide cable down to rock formation and never returned; rescuer Gary Seymour found some gear and clothing bloody and teeth-marred. Rescuer saw 12-ft blue shark and 12-ft mako shark; both made passes at him.
9/26	509	Port Everglades, Fla.	Walker, Robert	29	Hammerhead shark†	R	Fishing boat capsized and sank 3 mi offshore; victim clung to seat cushion throughout night; wearing khaki pants, white shirt, socks, no shoes; shark circled then bit both hands, pulling victim 5 ft under water; after he shook shark loose it returned twice, followed by 8 to 10 others which he fended off by kicking at them; sharks were still circling when rescued; 60 stitches necessary to close wounds to hands and feet.
9/30	638	Leyte, Philippines	Daguinot, Francisco	28		R	Swam away from swimming party into deep water and was attacked by shark.
9/?	682	Acapulco, Mexico	Woman (French)			F	Shark took off one leg and mutilated the other; victim died from loss of blood.
July-Sept	639	Machgaon near mouth of Devi River, India	35 victims	6 ft		F-5 R-30	"a sixfoot shark killed five persons and 30 others were injured in the course of the last two months in Machgaon at the mouth of the Devi River" (6).
10/2	645	Levuka, Fiji	Fijian cook of vessel <i>Andi Tui Lomaloma</i>	14 ft		F	Dived overboard to retrieve a dinghy near a wall. Attacked immediately, body not recovered.
10/4	554	Bodega Bay, Calif.	Hay, James	30	White shark (?)	R	20 ft below surface hunting abalones with companion; swam to surface, dragged under by violent jerk; swim fin bitten.
10/7	581	Xefina Island, about 20 mi from Lourenço Marques, Mozambique	Soldier (European)			F	Died in Lourenço Marques Hospital.
11/10	620	Northern Los Angeles County, near Paradise Cove, Malibu, Calif.	Fryling, Duffie	21		R	Attacked on arm while swimming underwater through a school of 2.5- to 5-ft sharks.
11/22	625	Northcliffe Beach, Brisbane, Australia	Sachse, Jeffrey E.	19	Whaler shark? 10 ft	R	Attacked about 200 yd from shore during surf race, victim trailing the field. Shark tore away large portion of left leg muscle below knee; leg tendons and blood vessels badly damaged, also severe abrasions to right hand. Swimming underneath native house on piles; right leg torn off.
11/26	646	Kaparoka in the Rigo, Papua, New Guinea	Mari, Mauama	13		F	Standing in chest-deep water, about 7:30 A.M., when struck on right foot and leg; long cut.
11/28	647	North Burleigh Beach, Brisbane, Australia	Beaver, David	17		R	Attacked 300 yd from shore, swimming with 3 companions, victim farthest out; raining, about 3:00 P.M.; suffered severe injuries to legs and right hand.
11/29	619	Fairhaven Beach, near Lorne, Victoria, Australia	Holland, Chris	19	12 ft	R	Lost ear from dinghy in heavy seas, 1.5 mi offshore, dived off dinghy to retrieve it. Screamed and disappeared. Body recovered. Post-mortem left no doubt he had been attacked by shark.
12/19	643	Wynnum, Moreton Bay, near Brisbane, Australia	Mullens, Stanley A.	29		F	One of 17 Maldivians who spent 31 days adrift in small open boat, rescued 400 mi southwest of Ceylon, had legs badly lacerated during an attack by sharks.
Nov-Dec	664	Maldivian Archipelago, southwest of Ceylon	Woman			R	Saved man; then leg was bitten by shark.
	396	Mid-Atlantic between England and Africa	Green, Chas.				

\* Possibly *Carcharhinus*. † Probably *Sphyrna zygaena*

water immediately; do not tow them in a bag or on a line cinched to the waist.

4) As a rule, a shark will circle its intended victim several times; get into a boat or out of the water as quickly as possible after sighting a circling shark before it has time to make an aggressive pass. Use a rhythmic beat with the feet and do not make an undue disturbance in the water as you move toward the boat or the shore. If wearing SCUBA, it is best to remain submerged until you have reached the boat.

5) If a shark moves in and there is no time to get out of the water, try not to panic, and keep the shark in view. It is often possible to discourage a shark by releasing bubbles or, at close range, by deliberately charging it and hitting it on the snout with a club or "shark billy." Since the hide of a shark is very rough and may cause serious skin abrasion, hit the shark with your bare hands only as a last resort. Shouting underwater may or may not discourage a shark.

*Advice to survivors of air and sea disasters.*

1) Do not abandon your clothing when entering the water. Clothing, especially on the feet and legs, is your only protection against the rough skin of a shark.

2) Place wounded survivors in a life raft; all should use the raft if there is room.

3) Remain quiet; conserve energy.

4) If you must swim, use regular strokes, either strong or lazy, but keep them rhythmic.

5) Do not trail arms or legs over the side of the raft.

6) Do not jettison blood or garbage, for this attracts sharks.

7) Do not fish from a life raft when sharks are nearby. Abandon hooked fish if a shark approaches.

8) When a shark is at close range use "Shark Chaser" (U.S. Navy repellent) if it is available; the black dye will repel many species of sharks.

9) If your group is threatened by a shark while in the water, form a tight circle and face outward; if approached, hit the shark on the snout with any instrument at hand, preferably a heavy one. Hit a shark with your bare hand only as a last resort.

*Advice to all.*

1) Always swim with a companion.

2) Avoid swimming at night or in extremely turbid or dirty water where underwater visibility is very poor.

3) Keep your head when a shark is sighted; leave the water as calmly and quickly as possible.

4) If an attack does occur, all possible effort should be made to control hemorrhage as quickly as possible, even before the victim reaches shore. If the wound is serious, the victim should be hospitalized as promptly as possible.

5) Adopt a sensible attitude toward sharks. Remember that the likelihood of attack is less than that of being

struck by lightning. Attack, however, is almost assured when one deliberately grabs, injures, or in some other way provokes even a small and seemingly harmless shark.

**References and Notes**

1. The AIBS Shark Research Panel, composed of Leonard P. Schultz, Stewart Springer, and Perry W. Gilbert (chairman), was established on 25 June 1958. Subsequently, on 7 December 1958, the Shark Research Panel became affiliated with the AIBS Hydrobiology Committee and now functions as a panel of that committee. Broadly speaking, the Shark Research Panel is concerned with all aspects of the biology of elasmobranch fishes. It meets once every two months with its sponsors, the Biology Branch of the Office of Naval Research and the American Institute of Biological Sciences, in Washington, D.C., and to these meetings consultants from the United States and abroad are invited.
2. For a review of current Shark Research Panel projects see P. W. Gilbert, *Am. Inst. Biol. Sci. Bull.*, **10**, No. 1, 19 (1960).
3. Mr. Michael Lerner, president of the International Game Fisherman's Association, was especially helpful in securing information concerning shark attacks from nearly 200 IGFA club officers in all parts of the world. In addition, Dr. V. M. Coppleson and Dr. Gilbert Whitley (Australia), Dr. Tokiharu Abe and Mr. M. Hosina (Japan), Dr. Albert L. Tester (Hawaii), Dr. David Davies and Dr. J. L. B. Smith (South Africa), and approximately 15 scientists in the United States were most helpful in supplying documentation on specific shark attacks.
4. The assistance of Mrs. John D. Stelling and Mrs. Marilyn Malin in the preparation of the table is gratefully acknowledged.
5. The following sources were especially helpful: V. M. Coppleson, *Shark Attack* (Angus and Robertson, Sydney, 1958); I. Eibl-Eibesfeldt and H. Hass, *Sonderdruck aus Z. Tierpsychol.*, **16**, 739 (1959); G. A. Llano, "Airmen against the Sea," *Arctic, Desert, Tropic, Information Center Publ. No. G-104* (1955); S. Springer, "Sharks and Their Behavior," unpublished report in the files of Coordination Research and Development, U.S. Navy (1943); F. G. Wood, "Recommended Precautions and Procedures in Encounters with Barracudas and Sharks," unpublished report (1958).
6. *Times of India*, Bombay (11 Sept. 1959).

# Biological Availability of Strontium-90 from Atomic Tests

From 50 to 100 percent is available to the biosphere, depending on the immediate environment of the bomb.

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Strontium-90, produced by nuclear explosions, has received considerable attention as a potential hazard to human life. The suggestion has been made by W. F. Libby that this hazard might be reduced if nuclear explosions were conducted in a manner such that strontium-90 is incorporated in insoluble particles and is thus made unavailable to living organisms. Such incorporation would have to take place in the bomb cloud during the time required for condensation and solidification of the volatilized material. Since krypton-90, a gaseous predecessor of strontium-90, decays with a half-life of 33 seconds, the relevant time scale for condensation includes the first several minutes following detonation. Very little is known about physical conditions in a bomb cloud during this period. However, visual observations indicate that condensation of the main body of the debris occurs during the first minute, even for megaton explosions.

The experiments described here provide data concerning the solubility and biological availability of strontium-90 in samples collected from the airborne debris from devices which were exploded in a number of different environments. The experiments were designed not only to provide information on the incorporation of strontium-90 in relation to device yield and matrix material but also to establish a simple test for strontium-90 availability, as a parallel

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to the classical ammonium acetate method for determination of the exchangeable calcium content of soil (1).

The methods employed for collection and preparation of the debris samples were such that alteration of the particles was kept to a minimum. Samples were collected by airplanes from atomic-test clouds on dibutylphthalate-impregnated cellulose filter panels. The portion of the panel selected as a sample was treated with ether to remove the dibutylphthalate, and the cellulose was then destroyed with atomic oxygen at a low temperature (100° to 150°C). The residual material was suspended in water, 1F HCl, or isopropyl alcohol, as desired.

Aliquots were removed from the water suspensions at approximately 7 days and again at 400 days after preparation. These aliquots were filtered with type VF Millipore filters (2), and the retained material was treated with 1F HCl for a period of 48 hours. The acid suspension was then filtered with a type VF filter, and the three fractions—water, 1F HCl, and insoluble residue—were analyzed for strontium-90 (3). Samples which were originally suspended in 1F HCl were treated similarly; however, only two fractions (1F HCl and insoluble residue) were obtained.

Barley plants were grown in soil samples in which were incorporated the water-insoluble fractions from portions of the various water suspensions of bomb debris. The portion of the suspension selected for each growth experiment was centrifuged, and the supernatant liquid was filtered with a type VF filter. The insoluble residue from the centrifugation and filtration

was washed and incorporated in a 317-gram portion of soil. After removal of about 10 grams of soil for strontium-90 analysis, one crop was grown in each of three 100-gram portions of each soil sample. The method for growth of the plants was essentially that of McGeorge (4), with 0.05 gram of NH<sub>4</sub>H<sub>2</sub>PO<sub>4</sub> and 0.05 gram of KNO<sub>3</sub> added as fertilizer for each crop. The seedlings were cut off 0.25 inch above the soil at the end of 17 days. Only the tops were analyzed for strontium-90 because of the difficulty of removing the soil from the roots. The calcium contents of the plants, roots, seeds, and soil and the strontium-90 contents of the plants and soil samples were determined (5).

Data from the experiments on assimilation of strontium-90 from the soil samples are presented in Table 1. Included are a sample of carrier-free strontium-90 and a sample consisting of the water-soluble fraction from a debris sample. The values of exchangeable and total calcium in the soil are 0.816 milligram and 2.0 milligrams of calcium per gram of soil, respectively. The 100 seeds from which each crop was grown contained, on the average, 1.6 milligram of calcium. The roots, which were not included in the crop, contained about 30 percent of the total calcium in the plants. We estimate that an average of 1.0 milligram of the calcium in each crop originated in the seed.

Data from the experiments on solubility of strontium-90 in debris samples are presented in Table 2. For samples 1 through 10 the data are given as the fraction of the total strontium-90 in each sample which is soluble in water, insoluble in water but soluble in 1F HCl, or insoluble in 1F HCl. For samples 11 through 13 the data are given as the fraction of the total strontium-90 which is soluble in 1F HCl or insoluble in 1F HCl.

The "biological availability" of the strontium-90 in a sample is obtained from assimilation data. The method of calculation is indicated in the two following definitions.

Relative uptake of strontium-90 from a sample equals

$$\frac{(\text{Sr}^{90} \text{ in crop})}{(\text{Sr}^{90} \text{ in soil})} + \frac{(\text{Ca in crop} - \text{Ca from seed})}{\text{exchangeable Ca in soil}}$$

Biological availability of strontium-90 in a sample equals the ratio: relative uptake of strontium-90 from a sample

Table 1. Assimilation of strontium-90 by barley plants from soil containing debris from atomic tests. Samples 1 through 10 contain the water-insoluble fractions of debris from atomic tests Nos. 1 through 10, respectively; sample 60 contains the water-soluble fraction of debris from test 6; and sample 0 contains carrier-free strontium-90.

Soil sample No.	Duration of water leach (days)	Crop No.	Sr <sup>90</sup>		Ca in crop
			In crop (count/min)	In soil (count/min gm)	
0		1	5788	2950	3.08
		2	4868	-	2.18
		3	7735	-	3.37
1	170	1	319	256	2.98
		2	298	-	2.87
		3	298	-	3.11
2	170	1	500	420	3.45
		2	649	-	3.75
		3	361	-	3.75
3	200	1	183	591	4.48
		2	119	-	3.40
		3	129	-	3.40
4	140	1	286	167	3.28
		2	278	-	3.41
		3	379	-	4.77
5	180	1	35	11.2	3.85
		2	33	-	3.82
		3	20	-	2.92
6	130	1	20.4	15.1	2.32
		2	23.7	-	3.80
		3	22.7	-	3.04
7	200	1	143	262	2.03
		2	288	-	3.75
		3	311	-	3.95
8	120	1	242	624	3.93
		2	142	-	2.98
		3	137	-	3.11
9	200	1	1063	259	4.41
		2	1085	-	5.25
		3	936	-	3.85
10	160	1	91	31.7	3.89
		2	90	-	4.50
		3	68	-	3.58
60	130	1	2451	649	4.46
		2	2376	-	4.26
		3	1667	-	3.08

Table 2. Solubility of strontium-90 in bomb debris from atomic tests.

Atomic test and sample No.	Time elapsed from shot to collection (hr)	Sr <sup>90</sup> distribution*			Duration of exposure	
		Water	1F HCl	Residue	Water (days)	Acid (days)
1	1.3	0.45	0.26	0.29	7	2
		0.64	0.25	0.11	420	2
2	1.5	0.58	0.24	0.18	7	2
		0.63	0.19	0.18	420	2
3	4.3	0.49	0.069	0.44	7	2
		0.64	0.014	0.35	450	2
4	2.1	0.91	0.072	0.018	8	2
		0.91	0.070	0.024	390	2
5	1.7	0.95	0.020	0.030	7	2
		0.98	0.009	0.010	420	2
6	1.8	0.49	0.47	0.036	7	2.5
		0.98	0.016	0.007	390	2
7	2.1	0.65	0.17	0.18	7	2
		0.76	0.053	0.19	445	2
8	3.1	0.30	0.11	0.59	8	2
		0.44	0.077	0.48	390	2
9	2.8	0.36	0.64	0.005	7	2
		0.44	0.55	0.012	450	2
10	3.9	0.92	0.071	0.006	11	2
		0.97	0.024	0.009	410	2
11-1	6	0.98 <sub>2</sub>	0.018	0	0	6
11-2	9	0.99 <sub>3</sub>	0.005	0	0	7
11-3	12	0.98 <sub>0</sub>	0.020	0	0	23
11-4	28	0.98 <sub>4</sub>	0.016	0	0	6
12-1	6	0.98 <sub>2</sub>	0.018	0	0	4
12-2	9	0.99 <sub>4</sub>	0.006	0	0	4
12-3	26	0.98 <sub>3</sub>	0.012	0	0	5
13-1	6.5	0.99 <sub>3</sub>	0.005	0	0	8
13-2	8	0.99 <sub>3</sub>	0.007	0	0	8
13-3	11	0.99 <sub>6</sub>	0.004	0	0	7
13-4	28	0.98 <sub>3</sub>	0.012	0	0	10
13-5	28	0.97 <sub>9</sub>	0.021	0	0	10

\* See text.

to relative uptake of strontium-90 from carrier-free strontium-90.

The "acid solubility of strontium-90 in a sample is equal to the fraction of the strontium-90 which is soluble in 1F HCl. It is assumed that strontium-90 that is soluble in water is also soluble in 1F HCl.

The values of biological availability and acid solubility for a number of debris samples as calculated from the data in Tables 1 and 2 are presented in Table 3. It is important to note that the first ten of these samples are the water-insoluble residues from the debris samples and that the 11th is the water-soluble fraction of a debris sample. The values given for acid solubility were obtained by linear interpolation of the 7-day and 400-day data in Table 4 to obtain the value at the time the soil samples were prepared. The correlation factor between acid solubility and biological availability is 0.87.

A résumé of matrix, yield, and acid solubility information for gross debris samples from the 13 atomic tests is presented in Table 4.

The correlation factor of 0.87 shows that measurement of acid solubility is a suitable substitute for measurement of biological availability. Such a test can serve as a measure of the immediate availability of strontium-90 but not necessarily as a measure of the long-term availability. The need for this precautionary note is indicated by the solubility data for atomic tests number 1, 3, and 8, which demonstrate that a long-term dissolving process can occur in addition to a rapid dissolving process.

### Availability of Strontium-90 in Bomb Debris

Any completely successful attempt to reduce the biological availability of strontium-90 by incorporation of the strontium-90 in particles must meet certain requirements. These requirements are: (i) incorporation only in particles which are able to resist prolonged exposure to the weathering of soil and water; (ii) incorporation in particles which are large enough so that strontium-90 does not diffuse appreciably from the particles in 28 years; (iii) a temperature-time history for the condensation of the matrix which would allow incorporation of strontium-90 formed by decay of the noncondensable krypton-90 of 33-second half-life. The extent to which these requirements are met determines the extent to which the availability of

Table 3. Comparison of acid solubility with biological availability.

Sample No.	Water-insoluble fraction	
	Acid solubility	Biological availability
1	0.55	0.52
2	0.55	0.40
3	0.093	0.076
4	0.78	0.59
5	0.42	0.88
6	0.83	0.67
7	0.37	0.39
8	0.15	0.10
9	0.99	1.00
10	0.85	0.76
60*	(1.00)*	(1.00)*

\* In order to demonstrate that water-soluble strontium-90 leached from bomb debris is completely available, the water-soluble fraction of debris from atomic test No. 6 was fed to plants. The sample is labeled 60.

strontium-90 is reduced. Complete failure for any one requirement presumably results in complete failure in the solubility reduction.

The debris from atomic test shots fired on iron towers in Nevada is apparently mostly magnetite. This is indicated by a typical red-brown color and by magnetic properties of the debris. Magnetic probes collected 85 and 50 percent of the fission-product activity from isopropyl alcohol suspensions of debris from tests 1 and 3. Less than 10 percent of the activity could be collected from debris from shots which were not fired on iron towers, with the exception of test 8, where 40 percent of the activity was collectible on a magnetic probe. Typical debris from shots fired in Nevada on balloons is composed of a mixture of black and light-yellow particles. Shots fired at the Pacific Proving Ground produce fluffy conglomerates of calcium carbonate or crystalline particles of sodium chloride from coral or sea water, respectively. It is interesting to note, for the Nevada shots, that the water solubility of fission products as a whole is generally considerably smaller than the water solubility of strontium-90. Typical values of solubility of fission-product activities are 13, 16, and 10 percent for tests 1, 3, and 7, respectively.

The existence of a substance such as magnetite or glass in widespread mineral deposits would seem to be evidence of its ability to resist prolonged exposure to the weathering of soil and water. The rate of dissolution of magnetite in water is not known, and the only evidence for the slowness of this rate is obtained from the 400-day water-leach experiments reported in Table 2. On the other hand, the etching of glass takes place in water in periods that are short by comparison with 28 years (6).

In any consideration of weathering the particle size or surface-to-volume ratio is important. Thus, in concluding that etching in water is important for glass, we consider particles with a diameter of the order of  $10^{-4}$  centimeter.

A second mechanism for loss of strontium-90 from particles consists of diffusion of the strontium-90 atoms to the particle surface followed by exchange of the strontium-90 with ions in the surrounding medium. In the absence of some extremely stable form for the incorporated strontium-90, the surface strontium-90 atoms will exchange rapidly by comparison with the 28-year half-life of strontium-90. On the other hand, diffusion of strontium-90 atoms from sites in the interior to sites on the surface will require a much longer time. The diffusion coefficient for strontium in magnetite is estimated to be  $10^{-23}$  to  $10^{-21}$  square centimeter per second. The corresponding diffusion rate is insignificant for a diffusion period

of 28 years and a particle size of  $10^{-4}$  centimeter. About 6 percent of the volume of a particle of  $10^{-4}$ -centimeter diameter lies within  $10^{-1}$  centimeter of the surface, and strontium atoms contained therein may be exchangeable.

The major fraction of the strontium-90 in fission products is formed by decay of krypton-90 to rubidium-90, followed by decay of rubidium-90 to strontium-90. Krypton is not incorporeal in condensing material. The fraction of the mass-90 chain ( $Kr^{90}$ - $Rb^{90}$ - $Sr^{90}$ ) present as krypton-90 in uranium-235 fission products is 0.6 at 9 seconds, 0.5 at 20 seconds, 0.2 at 1 minute, and 0.05 at 2 minutes (7). If the rubidium-90 can be incorporated in condensing material and if the fireball stays hot for about 2 minutes, then about 95 percent of the mass-90 chain—and, therefore, of the strontium-90—can be incorporated.

The solubilities of strontium-90 in debris samples from iron-tower shots

Table 4. Location, matrix, yield, and acid solubility of strontium-90 for atomic tests.

Atomic test No.	Location*	Matrix material	Energy released (kilotons)	Acid solubility of $Sr^{90}$ in gross debris samples	
				7 days	400 days
1	Tower, NTS	Lead Iron Concrete Paraffin	~10	0.71	0.89
2	Tower, NTS	Iron Silica Concrete	~10	0.82	0.82
3	Tower, NTS	Iron Magnetite concrete Concrete	~50	0.56	0.65
4	Balloon, NTS	Aluminum and miscellaneous Lead	~5	0.98	0.98
5	Balloon, NTS	Feldspar Aluminum and miscellaneous Lead	~10	0.97	0.99
6	Balloon, NTS	Feldspar Aluminum and miscellaneous Lead	~10	0.96	0.99
7	Balloon, NTS	Glass Aluminum and miscellaneous Lead	~50	0.82	0.81
8	Air burst, NTS	Glass Iron Aluminum	~50	0.41	0.52
9	PPG	Steel Concrete Coral island	>1000	1.00	0.99
10	PPG	Steel Coral Sea water	>1000	0.99	0.99
11	PPG	Steel Silica Sea water	>1000	0.99	0.99
12	PPG	Steel Sea water	>1000	0.99	0.99
13	PPG	Steel Concrete Water Coral island	>1000	0.99	0.99

\* NTS, Nevada Test Site; PPG, Pacific Proving Ground. A typical tower contained about 100 tons of material. A typical balloon contained a few tons of material. The air burst involved less material than the balloon.

in Nevada range from 0.56 to 0.89; the shot of highest yield produced the debris with the lowest solubility. The solubilities of strontium-90 in debris from balloon and air shots in Nevada range from 0.41 to 0.99; the shot of highest yield produced the debris with the lowest solubility. The strontium-90 in debris from Pacific shots is uniformly acid-soluble.

These observations indicate that all three requirements have been partially fulfilled for Nevada shots but that at least one of the requirements has not been met at all for Pacific Proving Ground shots. The temperature-time requirement should be most nearly fulfilled for tests in which the energy release is very large and the heat capacity of the debris is relatively small. The heat capacity of the debris is not relatively small for most Pacific shots. The uniform solubility of debris from these shots can be attributed to dilution of the fireball by large quantities of coral or sea water. This dilution has two effects. It cools the fireball rapidly and provides soluble particulate matter as a matrix (calcium carbonate, calcium oxide, sodium chloride—all soluble in 1*F* HCl). Unfortunately, no debris samples were available from megaton air bursts, in which both of these effects would be absent.

The most encouraging data come

from test number 8, an air burst with a matrix of aluminum and iron. The solubility of the strontium-90 in debris from this test was only 0.52 after exposure to water for more than a year. Although temperature-time histories of fireballs formed by atomic explosions of this magnitude are not known, a condensation time of 20 to 30 seconds is a reasonable assumption. The 0.52 solubility of the strontium-90 observed for test number 8 is consistent with complete incorporation of the rubidium-90 and strontium-90 present in the fireball 20 seconds after the explosion. The data from test number 8 indicate that a small amount of material can incorporate strontium-90 in an insoluble form, provided that the fireball stays hot long enough for the krypton-90 to decay. The data from the Nevada tower shots indicate that the use of much larger quantities of material does not reduce the solubility.

It is reasonable to assume that the important requirements for incorporation of strontium-90 are that the greater part of the condensable material in the fireball be capable of forming insoluble particles and that the condensation of this material take place as long as possible after the explosion, to allow for decay of krypton-90. On this basis it is conceivable that a megaton burst at an altitude of several miles, involving

several tons of aluminum or iron, would produce debris in which 80 percent or more of the strontium-90 would be insoluble. However, the likelihood of such an outcome should be regarded as a hypothetical possibility rather than as a distinct probability.

A megaton burst at ground level on a thick layer of magnetite should produce debris with a solubility equal to or less than the 0.65 solubility observed for test number 3. Such a ground-level environment would involve the disadvantage of a short condensation time, due to the heat capacity of the material engulfed by the fireball, and the possible advantage of increased local fallout as opposed to world-wide fallout. The choice of air versus surface environment would presumably be influenced by the amount of soluble strontium-90 which each would supply to the biosphere.

#### References and Notes

1. W. P. Kelly, *Cation Exchange in Soils* (Williams and Wilkins, Baltimore, 1948).
2. The filters are produced by Millipore Filter Corp., Watertown, Mass. Type VF filters are said to retain particles larger than 100 angstroms in diameter.
3. E. A. Bryant, J. E. Sattizahn, B. Warren, *Anal. Chem.* **31**, 334 (1959).
4. W. T. McGeorge, *Soil Sci.* **62**, 61 (1946).
5. L. C. Kuang, T. Kurtz, R. H. Bray, *Anal. Chem.* **24**, 1640 (1952).
6. G. W. Morey, *Properties of Glass* (Reinhold, New York, 1954).
7. R. C. Boiles and N. E. Ballou, "Calculated activities and abundances of  $U^{238}$  fission products," *U.S. Naval Radiol. Defense Lab. Rept. No. NRDL-456* (1956).

major behavioral characteristics, as measured by objective personality inventories, of a large number of post-adolescent youth of exceptional mental ability.

Early studies of intellectually gifted children were undertaken, at least in part, to examine the notion then commonly held that extraordinary mental proficiency is usually accompanied by physical frailty, early and drastic decline of abilities, insanity, or other compensating deficiencies. These misconceptions were readily refuted by the work of Terman (2) and Hollingworth (3). But early success in establishing that certain traits are not characteristic of the gifted has not been followed by much success in determining what is consistently characteristic of the gifted, other than exceptional intellectual ability.

The term *gifted* is often used to

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## Personality Attributes of Gifted College Students

Gifted students are less authoritarian and show more esthetic and intellectual interest than other students.

Jonathan R. Warren and Paul A. Heist

Education at all levels has been permeated in recent years with a tremendous concern for the adequate development of superior and gifted students. Most of the attention and effort has been directed toward identifying such students and devising edu-

cational processes suited specifically to their needs. Relatively few attempts have been made to re-examine personality attributes of such individuals with the improved assessment devices of the post-World War II period. This study (1) represents an appraisal of some

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include persons having exceptional musical, artistic, or other creative talent. In this article the term refers only to the intellectually superior as they are identified by a test of scholastic aptitude.

The level of scholastic aptitude, or the intelligence quotient (I.Q.), above which the classification of giftedness is considered appropriate is somewhat arbitrary, depending largely on the preference of the person applying the term and the context in which it is to be used. While Terman's lower limit was a Stanford-Binet I.Q. of 140, some investigators have set the limit at 120 or even lower. A majority seem to have settled on 130 as a useful lower limit for defining intellectual giftedness. Estimates derived from a conversion of College Entrance Examination Board Scholastic Aptitude Test scores to Stanford-Binet I.Q.'s indicate that the sample described below has a mean Stanford-Binet I.Q. approximating 150, with a minimum at about 130 (4).

Previous investigations have shown that the highly intelligent, as compared with those of average intelligence, are generally taller, heavier, physically healthier, and perhaps mentally healthier (2, 3, 5). The most frequently discovered psychological attribute of the intellectually gifted is a general self-sufficiency, a greater than usual degree of self-direction, independence, or autonomy. Such behavior is apparent both in intellectual pursuits and in more overt forms of behavior (6-8). Perhaps closely related is a tendency to dominate in social situations or, more accurately, a tendency not to be submissive. Here a sex difference has been noted, the lack of submissiveness being more characteristic of gifted men than of gifted women (5, 7, 8).

The greater cognitive scope and mental facility of the gifted seem to give them a greater command of themselves and their world, allowing them to be more adventurous and more creative—to engage in more varied and more difficult activities and to do so more intensely and more persistently—than the average person (7, 9). Notwithstanding their greater breadth of activity and more extensive contact with the external world, people of superior intellect are generally less tense, less anxious, and less given to feelings of insecurity and depression than are people in general (5, 10).

The broader, deeper interests of the gifted are directed toward themselves as well as toward the external world.

Gifted men, particularly, engage in more self-evaluation and self-criticism and tend more toward social withdrawal than do ordinary people. Gifted women are closer to the norm in both these respects (7, 8).

The large volume of material published in the last 30 or 40 years about the intellectually superior may suggest that more is known about the gifted than is indicated above. To be sure, other correlates of intellectual superiority, of a biographical or sociological nature, have been established: the proportions of gifted students from the various socioeconomic strata, the cultural levels of their homes, the steps in their educational progress, the vocations they entered, and so on. But as to generalizations about their way of thinking, their basic attitudes, and their manifest behavioral characteristics, there appears to be relatively little that can be concluded from the professional literature.

Generalized descriptions tend to obscure the heterogeneity of behavior known to exist among the gifted. Conversely, the diversity of the total population of gifted may not permit further generalization than has already been made. The data summarized here were assembled as a means of confirming what presumably has been established regarding gifted students in general and as a guide to further, more sharply delineated, studies of gifted students.

### Sample

In the spring of 1956, high school principals across the nation nominated 58,000 senior students to take the College Entrance Examination Board Scholastic Aptitude Test in a competition for college scholarships administered by the National Merit Scholarship Corporation. These 58,000, selected as the best senior students in their respective schools, constituted 6 percent of the national population of high school seniors. Slightly over 5000 of the highest scoring students, drawn proportionately from the various states according to their high school senior populations, were subsequently rated with respect to rank in class, motivation, breadth of interests, accomplishments, personality, and leadership potential. These ratings were based on autobiographical reports and high school principals' recommendations. Using the Scholastic Aptitude Test scores and the various ratings as predictors, a selection com-

mittee then designated as National Merit Scholars the 556 contestants considered to show the greatest promise of achievement in college. The remainder of the 5000 finalists were awarded certificates of merit (11).

Through an agreement with the National Merit Scholarship Corporation, the Center for the Study of Higher Education at the University of California initiated a longitudinal study of the entire group of National Merit Scholars and a 10 percent sample of the students awarded the certificate of merit (the near winners). [In this analysis the National Merit Scholarship winners and near winners collectively will be termed National Merit Scholarship students.] Over 90 percent of this total group agreed to participate in the study, 659 men and 259 women constituting the final sample.

The estimated mean and minimum I.Q.'s of 150 and 130, respectively, for this sample clearly justify designating these students as gifted. Unfortunately, the sample cannot be considered representative of the total population of intellectually gifted students of the same grade or age level. The initial nomination of 58,000 contestants was undoubtedly biased against the nonachieving gifted student. Even capable students with good achievement can be neglected in teachers' recommendations, as Getzels and Jackson (12) have shown. Boys appear in the sample studied 2.5 times as frequently as girls. The number of subjects who entered scientific and technological fields in college was over three times the number who entered other fields. A boy with a good high school record and an interest in science seems to have had a greater chance of being selected than would be indicated by his scholastic aptitude alone. A gifted girl interested in literature, who for some reason did not excel in terms of high school grades, would have had little chance of being included in the sample studied.

Neglected in the above consideration of sample bias is the effect of proportional selection by states. Probably because of disparities among systems of education from one state to another, a student with a given aptitude score might be selected as a finalist in one state and not in another where the competition was stiffer. Whether this selection procedure offsets inequalities produced by the accessibility to some students of superior educational opportunities or introduces inequalities of its own cannot be answered.

## Procedure

Among the several assessment instruments used in the study were the Omnibus Personality Inventory (13), administered in the summer of 1956, prior to the students' entrance into college, and the Study of Values (14), which was administered in the spring of 1957.

*Personality inventory.* The Omnibus Personality Inventory consists of an assemblage of personality scales that were considered to be particularly pertinent to the study of college students (15). The scales were drawn from other inventories and from research by other agencies. Brief descriptions of the attributes that the scales primarily measure and statements of the origins of the scales are given below.

The Thinking Introversion (TI) scale of Evans and McConnell (16) was incorporated into the Omnibus Personality Inventory unchanged with respect to content but with the original Likert response form replaced by a true-false form. High scorers show a liking for reflective thought, particularly thought of an abstract nature, and are interested in ideas and concepts; they tend to be less influenced by external conditions and commonly professed ideas than are low scorers.

The Complexity (Co) scale, adapted from the work of Barron (17), distinguishes between people who perceive and react to complex aspects of their environment and those who react to more simple stimulus patterns. High scorers are more independent, liberal, critical, unconventional, and potentially more original and creative; they welcome the new and different in their experiences. Low scorers tend to be compliant and conservative, accepting authority and tradition, and to respond to simpler perceptual patterns.

The Originality (O) scale, adapted from research by Barron (18) and Gough at the University of California Institute for Personality Assessment and Research, measures a tendency toward highly organized but individual ways of reacting to the environment. Characteristics of high scorers are independence of judgment, freedom of expression, rebelliousness, rejection of suppression, and novelty of insight.

The Responsibility (R) scale was initially developed by Gough, McCloskey, and Meehl (19) to measure responsibility as it pertains to social activity. High scorers tend to be thorough, planful, conscientious, socially

progressive, and concerned with social and moral issues.

The Ego-strength (Es) scale was originally developed by Barron (20) to measure some aspects of the ability to function effectively as a person. The version of the scale used in this study is a short form of the original (31 rather than 60 items). High scorers are more alert, adventurous, determined, independent, outspoken, persistent, and resourceful than low scorers.

The Social Maturity (SM) scale, derived from research with the Authoritarian scale of Adorno, Frenkel-Brunswik, Levinson, and Sanford (21) but scored in the reverse direction (toward nonauthoritarianism), measures the more indirect, more personality-centered elements of the authoritarian construct, avoiding most items having a political or ideological connotation. This is also a short form of the originally developed Social Maturity scale. High scorers, in contrast to low scorers, are more culturally sophisticated and more confident as well as less compulsive, less submissive, less conventional, and less punitive.

The original Authoritarian (F) scale (form 45/40) was also included in the Omnibus Personality Inventory, but with two of the original 30 items removed and with the responses altered from the Likert to the true-false form. This Authoritarian (F) scale correlates highly but negatively with the Social Maturity scale, as would be expected. High scorers on the Authoritarian scale have an in-group orientation and tend to be repressive, rigid, conventional, emotionally cold, and prejudiced.

The Impulse Expression (IE) scale was developed by Sanford, Webster, and Freedman (22) at Vassar. High scorers tend to be impulsive, irresponsible, impatient, erratic; low scorers are generally reserved, dignified, cautious, and dutiful, sometimes to the point of being placid or taciturn.

The Social Introversion (SI) scale was developed by Drake (23), who used items in the Minnesota Multiphasic Personality Inventory (24). High scorers show relatively little active interest in people; low scorers appear to be primarily socially oriented.

Four scales in the Omnibus Personality Inventory, borrowed from the Minnesota Multiphasic Personality Inventory, measure some aspect of adjustment or maladjustment. They are the Hysteria (Hy), Psychopathic Deviate (Pd), Schizophrenia (Sc), and Hypomania (Ma) scales.

*Study of values.* The second personality inventory, the Allport-Vernon-Lindzey Study of Values, measures six value orientations (14). A high score on the Theoretical (Th) scale indicates a person with a dominant interest in the discovery of truth, one who is concerned with cognitive approaches to reality and who is critical, rational, and given to intellectualizing. (Findings at the Berkeley center show interest in scientific fields to be a strong correlate of this orientation.) The person who scores high on the Economic (Ec) scale is interested primarily in the utilitarian and the practical, in the accumulation of material goods and associated activities. The high scorer on the Aesthetic (Aes) scale places greatest value on form and harmony. His major orientation is toward a pleasing organization of sensory experience, toward the esthetic aspects of the environment. The high scorer on the Social (Soc) scale is oriented toward people as such, without regard to theoretical, esthetic, or practical attitudes, which he may regard as cold and inhuman. A person who scores high on the Political (Pol) scale is not necessarily interested in the field of politics but is chiefly concerned with power and influence over others and the struggle and competition with which power is commonly associated. The person who scores high on the Religious (Rel) scale is something of a mystic, seeing the highest values in a search for the meaning of life and in comprehension of the cosmos (25).

The Allport-Vernon-Lindzey items are forced-choice alternatives, high scores on any one scale necessitating low scores on some other scale or scales. The six scores can therefore be interpreted only in relation to each other; a high score indicates only that that orientation is more highly valued than the others.

## Results

*Comparison groups of college students.* The Omnibus Personality Inventory was administered in 1957 to samples of unselected freshmen at two branches of the University of California. Scores from the two samples were combined to provide a single reference group more broadly representative of college students than either sample would have been alone. Study of Values scores for half the subjects in one of the University of California samples

were obtained at the same time. Allport-Vernon-Lindzey scores of two other college groups were available for purposes of comparison. The Study of Values manual provides means and standard deviations for a large sample of college students of both sexes, and Lehman and Ikenberry (26) report Allport-Vernon-Lindzey scores for a random sample of Michigan State University (MSU) freshmen of 1958. Since students in all four undergraduate years are represented in the data presented in the manual, and since the testing reported in the manual was done at least seven years before the National Merit Scholarship group was tested, the California and Michigan samples probably provide more appropriate comparisons for this study.

The mean aptitude of the Michigan sample is slightly higher than the national college freshman mean. The California freshmen, however, show a mean aptitude score a full standard deviation above the national mean. Although more than the usual amount of overlap therefore exists between the distributions of aptitude of the University of California and the National Merit Scholarship samples, their means are still sufficiently different (about 1.5 standard deviations apart) to permit meaningful group comparisons.

*Results on the personality scales.* Means and standard deviations for males in the National Merit Scholarship and University of California samples on the various personality scales in the Omnibus Personality Inventory are shown in Table 1. Similar data for women are shown in Table 2. The males in the scholarship sample are differentiated fairly sharply from the California male freshmen on all the scales except the four "adjustment" scales of the Minnesota Multiphasic Personality Inventory. Results for the women are very similar, with the exception of the mean scores on the Social Introversion scale, which do not differentiate the very bright women from the less bright.

For both sexes, the two scales showing the greatest differences between the gifted and the unselected students are Thinking Introversion and Responsibility. Interest in reflective thought, interest in working with ideas and concepts, and intellectual independence, all of which contribute to high Thinking Introversion scores, are characteristics of the intellectually superior that have been noted before (2, 27). Conscientiousness, thoroughness of planning

Table 1. Omnibus Personality Inventory scale means and standard deviations for National Merit Scholarship (NMS) men and for University of California (UC) male freshmen.

Scale	NMS (N, 659)		UC (N, 191)	
	Mean	S.D.	Mean	S.D.
TI*	45.1	8.7	34.2	10.6
Co*	14.7	3.9	13.2	4.1
O*	24.9	4.5	22.2	4.8
R†	41.5	4.3	36.6	8.3
Es*	22.5	3.1	21.5	3.1
SM*	36.0	5.4	31.0	6.8
F*	8.3	4.2	11.3	4.4
IE*	21.2	6.8	24.2	6.9
SI*	24.7	9.0	27.2	9.2
Hy	20.2	4.1	20.4	4.5
Pd	21.1	4.1	22.1	4.3
Sc	26.8	7.1	27.6	7.0
Ma	20.2	4.2	20.8	3.9

\*  $p < .001$ . † Because of the difference in variances of the two groups, no test for significance was performed.

ning, and concern with moral issues, traits measured by the Responsibility scale, have been less clearly indicated in previous research with the gifted.

The gifted students observed by Brandwein (9) showed a considerably higher degree of persistence and more thorough planning than did the less bright. Hollingworth (3) noted an early concern with and continued interest in moral issues in the gifted. Both of these rather distinct traits contribute to high Responsibility scores. A difficulty of interpretation is introduced, however, by the combination, in Brandwein's subjects and in the subjects of the present study, of high intelligence and unusual success in school. The thoroughness and persistence that seem characteristic of these students could therefore be considered functions of achievement, a learned and rewarded form of behavior, rather than of intellectual superiority as such. A heightened moral awareness may or may not be contributing to the higher Responsi-

bility scores of the gifted; its influence cannot be separated from that of conscientiousness and thoroughness.

Again for both sexes, the differences between the two groups with respect to originality support the observation of Hildreth (27) and others (2, 3, 7) that the gifted show unusual originality, imagination, inventiveness, and resourcefulness. Other correlates of high Originality scores—freedom of expression, rebelliousness, and lack of suppression (13)—have not commonly been ascribed to the gifted. Moreover, their low Impulse Expression scores seem, at first glance, to contradict the picture of the gifted implied by high Originality scores as freely expressive and unsuppressed individuals. The scores on these two dimensions, however, are not actually contradictory. People with high Impulse Expression scores tend to be impulsive, irrepressible, and ready to express their impulses in overt action when the content of the impulse tends to be emotional or affective. The freedom of expression indicated by high Originality scores is essentially of a cognitive or attitudinal nature. (There is a positive correlation between the Impulse Expression scale and neurotic patterns on the Minnesota Multiphasic Personality Inventory. Correlations between Originality and Impulse Expression are virtually zero.) The high Originality and low Impulse Expression scores of the gifted, then, show the gifted to be, by comparison with average individuals, more original, imaginative, rebellious, and expressive with respect to cognitive material but somewhat more reserved and cautious with respect to affective material. To the limited extent that human behavior can be dichotomized, the distinction might be made that the gifted are intellectually and conceptually imaginative and "impulsive," whereas emotionally they are more controlled. From the psychoanalytic standpoint, the gifted seem to "operate" more at the ego level than at the id level.

The studies of both Hollingworth (3) and Terman (2), as well as of others (7, 8), strongly suggest that the greater intellectual powers of the gifted, in comparison with average students, permit them to react to their environments with greater imagination, resourcefulness, and flexibility, to be less bound by conventional modes of reacting, and to have greater confidence in their own ability to cope with their environments. The results on the Social Maturity and Authoritarian scales confirm this view.

Table 2. Omnibus Personality Inventory scale means and standard deviations for National Merit Scholarship (NMS) women and other female college freshmen (UC).

Scale	NMS (N, 259)		UC (N, 197)	
	Mean	S.D.	Mean	S.D.
T*	46.9	7.4	36.5	9.4
Co*	14.7	3.8	12.8	3.8
O*	25.6	3.7	23.0	4.3
R†	42.5	3.9	39.1	5.0
Es*	22.5	3.1	21.4	3.1
SM*	35.0	5.1	32.6	6.6
F*	7.7	4.0	9.5	4.2
IE*	18.6	7.6	21.4	7.8
SI*	25.3	8.6	26.4	8.6
Hy	20.9	3.5	21.9	4.0
Pd*	20.5	3.4	21.6	3.9
Sc	26.4	4.9	27.6	5.3
Ma	19.1	4.1	20.3	4.4

\*  $p < .001$ .

Table 3. Allport-Vernon-Lindzey means and standard deviations for National Merit Scholarship (NMS) men, for other male college freshmen (UC and MSU), and for other male college students (norms.)

Scale	NMS (N, 604)		UC (N, 82)		MSU (N, 256)		Norms (N, 851)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Th	48.1	8.4	48.8	7.6	44.8	6.6	43.3	7.6
Ec	36.0	8.9	38.8	9.0	43.7	6.4	42.1	9.1
Aes	39.3	10.3	37.3	9.7	31.8	7.2	37.2	9.7
Soc	34.2	7.6	35.4	7.5	35.0	6.2	37.7	7.2
Pol	40.4	7.1	41.5	7.3	42.8	6.0	42.7	6.8
Rel	41.7	11.0	38.1	9.3	41.9	8.3	37.0	10.4

In addition to indicating greater maturity and less authoritarianism, scores on these scales indicate greater flexibility and less compulsiveness and conventionality in the National Merit Scholarship subjects than in the University of California subjects. The higher Social Maturity scores of the gifted indicate more sophistication and greater self-confidence as well.

The distinctive performance of the gifted subjects on the Social Maturity and Authoritarian scales is noteworthy for a more general reason. These two scales, more than any others, denote what a number of personality theorists would consider a basic personality dimension. The more advanced psychological development of the gifted, indicated by results on these scales, and the correspondingly greater potential for growth and positive change may, as much as superior mental ability, provide the basis for superiority both in achievement and in more general forms of behavior in an academic environment.

Two more scales add elements to the picture of the personality organization of the gifted that complement these findings. The higher Ego-strength scores of the National Merit Scholarship subjects suggest that they operate at a higher level of personal effectiveness and, again, that they are more self-confident, resourceful, and independent than the less bright. Their higher Complexity scores indicate, once more, greater intellectual independence and a

tendency toward original, unconventional ways of responding to the environment as well as greater tolerance of ambiguity and greater potential for creativity.

The intellectual rebelliousness, the experimenting attitude toward ideas, the freedom to express somewhat deviant forms of thinking (characteristics associated with high Originality scores); the intellectual independence and affinity for scholarly pursuits of those scoring high on the Thinking Introversion scale; the ego strength, potential for creativity, and associated qualities just mentioned—all these, added to the psychological maturity indicated by the Social Maturity and Authoritarian scales, describe a personality "structure" and a way of thinking which would be highly conducive to intellectual achievement.

The only marked difference by sex is found on the Social Introversion scale. The lower Social Introversion scores of the gifted men, as compared with university freshmen, indicate a greater interest in people and less of a tendency to withdraw from social contact. No such difference appears between gifted and more typical college women.

The last four scales in Tables 1 and 2, taken from the Minnesota Multiphasic Personality Inventory, all measure some aspect of maladjustment. For men, the National Merit Scholarship subjects as a group score lower on all four scales than do other university freshmen, the differences being significant at the 0.05

level or better. For women, although the means of the National Merit Scholarship group are slightly lower than corresponding means of the comparison group, the only significant difference is on the Psychopathic Deviate scale. Scores on this group of scales indicate clearly that the gifted students of both sexes in this sample have no higher incidence of maladjustment than do unselected university freshmen. In fact, they suggest the contrary. The original selection procedure, however, may have operated to exclude from the sample gifted students who would show evidence of some emotional disturbance or maladjustment, thus biasing these results somewhat toward an overestimation of the mental health of the gifted.

*Results on the study of values.* Means and standard deviations of scores on the Allport-Vernon-Lindzey Study of Values for the National Merit Scholarship students and for two other contemporary samples of college freshmen, as well as norms from the Allport-Vernon-Lindzey manual, are presented in Tables 3 and 4.

Because of the interdependence of scores on the six Allport-Vernon-Lindzey scales, tests of significance were not applied to the differences between groups on individual scales. Standard deviations have been included in Tables 3 and 4 to permit a superficial evaluation of the relative magnitudes of the differences observed. A statistical comparison (discriminant function analysis) of the total sets of six value scores for the National Merit Scholarship and Michigan State University groups confirms the impression that these two profiles are significantly different. Interpretation of the differences between all four profiles is facilitated by reference to the complete profiles presented in Figs. 1 and 2.

For both sexes, the profiles diverge most sharply on the Theoretical, Economic, and Aesthetic scales. The gifted students value the theoretical and aesthetic orientations relatively higher and the economic, or utilitarian, relatively lower than do the students in the comparative samples. The only exception appears in the Theoretical scores of National Merit Scholarship and University of California men, which are virtually equal. Here, though, the high scores of the men in the University of California sample may be attributed to their high level of aptitude and the large proportion of science majors found in the sample. No undergraduate sample presented in the manual approaches the

Table 4. Allport-Vernon-Lindzey means and standard deviations for National Merit Scholarship (NMS) women, for other female college freshmen (UC and MSU), and for other female college students (norms).

Scale	NMS (N, 174)		UC (N, 59)		MSU (N, 197)		Norms (N, 965)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Th	43.7	8.6	39.1	8.4	39.0	6.9	36.4	7.4
Ec	30.5	7.7	35.1	7.1	38.3	6.6	38.8	7.5
Aes	45.0	9.6	43.0	10.2	38.3	7.1	42.2	8.7
Soc	37.5	7.6	39.5	7.0	39.2	6.7	41.3	7.0
Pol	36.7	6.6	39.2	6.7	39.3	6.3	38.1	6.1
Rel	46.5	9.7	43.8	10.2	45.8	7.7	43.2	10.5

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The gifted, then, take greater interest than do the more typical students in cognitive and intellectual pursuits. They are more concerned with harmony and form in sensory experience and have a greater appreciation of the artistic. These higher theoretical and esthetic values appear in connection with a lower interest in the utilitarian and the practical.

While the comparisons just given hold equally well for both sexes, the differences by sex that appear within the comparison groups are also present in the National Merit Scholarship sample. The unselected males in all the comparison samples evaluate the three orientations with respect to which the major differences occur, in decreasing order, theoretical, economic, esthetic. The gifted males evaluate them theoretical, esthetic, economic. For the unselected women, no consistent ordering of these three values appears. The gifted women, in contrast to the men, value the esthetic orientation slightly higher than the theoretical, while sharply rejecting the economic.

Differences on the other three scales—Social, Political, and Religious—between gifted and unselected students are slight but provide some information when considered in conjunction with other measures. For both sexes, the lower Political scores, indicating relatively little value placed on a power orientation, find support in the differences obtained in the measures of authoritarianism (Social Maturity and Authoritarian scales).

Scores on the Allport-Vernon-Lindzey Social scale indicate that gifted college students of both sexes may be slightly less socially oriented than unselected college students of the same sex. The Omnibus Personality Inventory Social Introversion scale, however, indicates the reverse, particularly among the men. The apparent contradiction may be due to depression of the Allport-Vernon-Lindzey Social scores by the strong theoretical orientation of the men, while the depressing effect of the women's high scores may have operated on Economic more than on Social scores. Among males, then, the economic orientation seems to take precedence over the social orientation, while the reverse seems true for the women.

Among these six interdependent scales, the Religious scores are often the ones depressed by high theoretical or esthetic values. Yet the gifted of both sexes

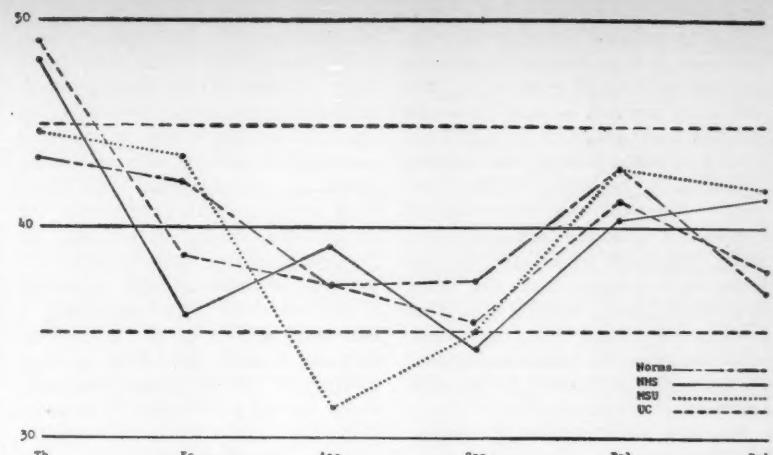


Fig. 1. Mean score profiles on the Study of Values from groups of men students: a normative group, National Merit Scholarship sample, Michigan State University, and University of California.

score as high on the Religious scale as do any of the groups used here for comparison (in some cases the gifted score higher), while scoring high on the Theoretical and Aesthetic scales as well. The extensive religious interests and commitments observed in the National Merit Scholarship students are clearly evident in the results of the test.

## Discussion

Integration of some of the Omnibus Personality Inventory and Allport-Vernon-Lindzey results brings sharply into focus a major conclusion of the

study. Accompanying the high scholastic aptitude of the gifted is a strong attraction to intellectual activity combined with high levels of esthetic awareness and appreciation.

Both the Complexity scale of the Omnibus inventory and the Allport-Vernon-Lindzey Aesthetic scale, which correlate about 0.4, deal with the organization of experience. High Complexity scores, exhibited by the gifted of both sexes, indicate a preference for complex stimulus patterns and an inclination and ability to deal imaginatively and adequately with apparent disorder. High Aesthetic scores, exhibited particularly by the gifted women, indicate a re-

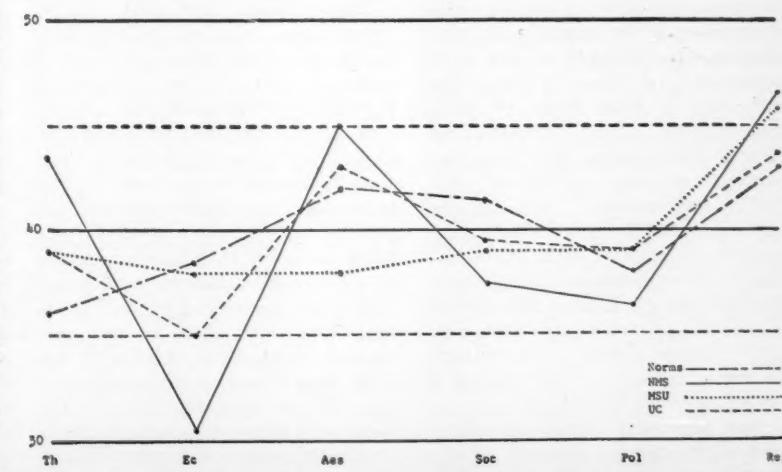


Fig. 2. Mean score profiles on the Study of Values for groups of women students: a normative group, National Merit Scholarship sample, Michigan State University, and University of California.

ceptive orientation toward sensory experiences and possibly a predilection for their harmonious organization. The two scales seem to measure somewhat different constructs: the cognitive approach to the organization of sensory experience is measured by the Complexity scale and the more affective approach is measured by the Aesthetic scale. The mean scores on these two scales, with support from the mean Theoretical scores, indicate that many gifted women value both approaches, while the gifted men place greater emphasis on the intellectual or cognitive approach.

Research on a number of student samples (28) has shown that high scorers on the Aesthetic scale are characterized by more than the traits attributed to them by the manual. High Aesthetic scores have repeatedly proved to be a strong correlate of scholastic and intellectual interests; the Aesthetic scale correlates with Thinking Introversion at a higher level than does the Theoretical scale. This orientation, often more than the theoretical, denotes a set of attitudes which serves as a strong component of intellectualism. A combination of high Aesthetic and high Theoretical scores is even more indicative of a strong intellectual orientation. One wonders whether the intellectual potential indicated by the combination of strong esthetic and theoretical orientations in the women of the sample will lead to intellectual and academic productivity or will remain undeveloped in the current cultural environment.

A reservation with regard to the differences between the gifted and the nongifted indicated by the foregoing findings should be restated. The gifted students who furnished the data which permitted the delineation of these differences are a select group of gifted, chosen partly because they possess desirable characteristics other than high academic aptitude. Criteria of sociability, responsibility, and emotional stability, in addition to achievement and aptitude, entered to some extent into their selection. Furthermore, high ability plus achievement is not a *sine qua non* of active, operative giftedness, and generalizations arrived at from patterns of mean scores are not necessarily typical of single individuals.

That personality characteristics other than high academic aptitude do distinguish the intellectually gifted from the general population seems clear. The results presented here for a large sample

of contemporary youth generally confirm characteristics of the gifted previously reported. More detailed knowledge of the ways in which nonintellectual attributes operate within the ranks of the gifted and differentially between the gifted and the nongifted may result from study of selected subgroups of the gifted. One should ask whether the theoretical orientation of the gifted, for example, is uniformly high, regardless of field of study, be it engineering, a theoretical science, or the humanities. One also wonders what other qualities differentiate the individuals of high ability having a utilitarian orientation from those with a theoretical orientation. Are the effects of high intellectual ability nonlinear, as Hollingworth has repeatedly proposed, the most desirable correlates occurring in a moderately high rather than in an extremely high range of ability? These and other questions await further research.

### Summary

Although considerable interest has been centered in recent years on ways to insure that intellectually gifted youth will develop their capabilities to the fullest, relatively little is known of the underlying personality characteristics common to the gifted. The study here reported was a re-evaluation, from objective personality inventories, of previously reported psychological attributes of the gifted and an attempt to identify additional personality characteristics that differentiate the gifted from the nongifted.

The attribute that most sharply differentiates the gifted of both sexes, as defined in this study, from groups of unselected college freshmen is a strong disposition toward intellectual activity. This can be described more explicitly as a liking for reflective and abstract thought; interest in ideas and conceptualization; a rational, cognitive approach to reality; and a positive, functional approach to scholarly pursuits. A second major differentiation, somewhat more pronounced in the women, appears in what seems to be a perceptual variable. The subjects of this study have a stronger esthetic orientation than is commonly found. The majority of them react preferentially to the artistic rather than to the utilitarian components in their environments.

Other differences in the two personality inventories, mostly confirmative of

previous research, indicate that the gifted are independent, confident, and generally mature in their interactions with the external world. As compared to the normative groups, they have more complex perceptions and reactions. They are less authoritarian and less rigid, to the extent that many are free to become "risk-takers" in the world of ideas. Most of them also react with greater originality, imagination, and resourcefulness to the stimulation they receive.

Although intellectually imaginative, critical, somewhat rebellious, and free to express themselves, the gifted are neither as emotionally expressive nor as impulsive as the average individual. This repression of affective behavior, however, does not produce social withdrawal. The gifted men, in fact, appear more socially oriented than do unselected college men. In neither sex is there a higher incidence of emotional disturbance or adjustment difficulties among the gifted than is found in the general college population.

Among the gifted, the women appear much more like the men with respect to most of the personality traits measured than is true in more general college samples. As with other college students, however, the gifted women place greater value, relative to other measured values, on an esthetic approach to experience than do gifted college men. Again as in groups of more typical college students, the gifted women place greater emphasis on social than on utilitarian values, while the reverse is true for the men.

The procedures used in selecting the gifted sample limit somewhat the applicability of the conclusions. Studies of more restricted subgroups of comparable ability levels should be informative and valuable.

### References and Notes

1. Collection and analysis of the data were made possible largely through the efforts of T. R. McConnell, chairman of the Center for the Study of Higher Education.
2. L. M. Terman and M. H. Oden, *Genetic Studies of Genius* (Stanford Univ. Press, Stanford, Calif., 1947), vol. 4.
3. L. S. Hollingworth, *Gifted Children: Their Nature and Nurture* (Macmillan, New York, 1926).
4. Equipercentile conversions for college populations were made from Scholastic Aptitude Test scores to Army General Classification Test scores and from the latter to Wechsler-Bellevue I.Q.'s. Stanford-Binet I.Q.'s were then estimated from comparable Wechsler-Bellevue I.Q.'s given by Wechsler (D. Wechsler, *The Measurement of Adult Intelligence* (Williams and Wilkins, Baltimore, ed. 3, 1944). Scholastic aptitude test norms for high school seniors [J. A. Fishman, 1957 Supplement to *College Board Scores No. 2* (College Entrance Examination Board, New York, 1957)] show that the means for the sample studied

are more than two standard deviations above the national means on both the verbal and numerical subtests. More than 99 percent of the subjects scored higher than one standard deviation above the means for the two subtests.

5. L. S. Hollingworth and M. M. Rust, *J. Psychol.* 4, 287 (1937).
6. H. O. Barrett, *Personnel and Guidance J.* 36, 192 (1957); W. D. Lewis, *J. Genet. Psychol.* 62, 301 (1943).
7. G. F. Lightfoot, *Teachers College Contrib. Educ.* No. 969 (1951).
8. C. G. Wrenn, L. W. Ferguson, J. L. Kennedy, *J. Social Psychol.* 7, 301 (1936).
9. P. F. Brandwein, *Gifted Student as Future Scientist* (Harcourt-Brace, New York, 1955).
10. J. B. Zeaman, *Dissertation Abstr.* 18, 290 (1958).
11. J. L. Holland and R. C. Stalnaker, *National Assn. Secondary School Principals Bull.* 42, 9 (1958).
12. J. W. Getzels and P. W. Jackson, *Phi Delta Kappan* 40, 75 (1958).
13. P. A. Heist and P. A. Williams, "Manual for the Omnibus Personality Inventory" (Center for the Study of Higher Education, Univ. of California, Berkeley, 1957).
14. G. W. Allport, P. E. Vernon, G. Lindzey, *Study of Values: A Scale for Measuring the Dominant Interests in Personality* (Houghton Mifflin, Cambridge, Mass., 1951).
15. John Darley and Martin Weissman originally assembled this omnibus inventory explicitly for use in research on students of superior ability.
16. C. Evans and T. R. McConnell, *J. Psychol.* 12, 111 (1941).
17. F. Barron, *J. Abnormal Social Psychol.* 48, 163 (1953).
18. ———, *ibid.* 51, 478 (1955).
19. H. G. Gough, H. McCloskey, P. Meehl, *ibid.* 47, 73 (1952).
20. F. Barron, *J. Consult. Psychol.* 17, 327 (1953).
21. T. W. Adorno, E. Frenkel-Brunswik, O. J. Levinson, R. N. Sanford, *The Authoritarian Personality* (Harper, New York, 1950).
22. R. N. Sanford, H. Webster, M. Freedman, "Impulse Expression as a Variable of Personality" (Vassar College, Poughkeepsie, N.Y., 1956).
23. L. E. Drake and W. B. Thiele, *J. Educ. Research* 41, 551 (1948).
24. S. R. Hathaway and J. C. McKinley, *Minnesota Multiphasic Personality Inventory Manual* (The Psychological Corp., New York, rev. ed., 1951).
25. Correlations between a few Omnibus Personality Inventory and Allport-Vernon-Lindzey scales are moderately high, but not to the point of curtailing the usefulness of the latter in adding to a description of gifted students. The Thinking Introversion scale, for example, correlates with the Allport-Vernon-Lindzey Economic scale from -0.4 to -0.6 for subgroups of National Merit Scholarship students in various fields of study.
26. Correlations of the Thinking Introversion with the Allport-Vernon-Lindzey Theoretical scale (two scales which may seem to be conceptually related) are low for the men of the sample, varying from 0.1 to 0.2. For women, the correlations between the same two scales are around 0.4. Correlations between the Complexity and the Allport-Vernon-Lindzey Aesthetic scale, for both sexes, approximate a value of 0.4. Intercorrelations for other scales on these two inventories are below 0.3. Both personality inventories are only minimally related to scholastic aptitude in terms of correlations for the sample studied. Correlations with Scholastic Aptitude Test-M uniformly approximate zero. A few correlations with Scholastic Aptitude Test-V are of the order of 0.2, most of them also approximating zero.
27. I. J. Lehman and S. O. Ikenberry, *A Preliminary Report: Critical Thinking, Attitudes, and Values in Higher Education* (Michigan State Univ., East Lansing, 1959).
28. G. Hildreth, *Educating Gifted Children at Hunter College Elementary School* (Harper, New York, 1952).
29. T. R. McConnell and P. A. Heist, *College and University* 34, 442 (1959).

## Science in the News

### The Republican Convention: Nixon's "Progressive Conservatism" More Progressive than Conservative

The Republican convention, like the Democratic, reflected the emergence of science and technology in national politics. Like the Democrats, the Republicans, for the first time, wrote into the party platform a pledge of continuing federal support for scientific research. Again the important news is not in the platform promises or in the routine references to the importance of science which appeared in so many of the speeches, but in the attitude of the candidate. And Nixon's attitude, like Kennedy's, is that the federal government should be spending more money on science and much more on programs to produce more well-trained scientists.

There are sharp differences between the two men, but in the areas of science and particularly education there is at least a basic common agreement. The agreement stems, if from nothing else, from the strong awareness of both men of the emergence of science as a major component of a nation's power and prestige, and the consequent aware-

ness not only of the importance of federal support of science, but of federal support of programs to develop scientific talent. Nixon has gone out of his way to make it as clear as he can, short of outright criticism of Eisenhower, that he believes that, particularly in the area of programs affecting national security, the Eisenhower administration has tended to think too much in terms of how much we can cut the budget and not enough of how much we should be doing. And as noted above, Nixon, like Kennedy, has recognized science and education as areas with a direct effect on national security.

Nixon, so far at least, seems to be thinking of expanded research in more limited terms than Kennedy: he is inclined, by his personal beliefs and by his commitments as a Republican candidate, to think of spending less than the Democrats, and he seems to be concentrating his attention, more than Kennedy, on programs of obvious practical value, particularly defense research and development and the space program with its important propaganda value.

On education, again reflecting his

personal and his party inclination to keep the role of the federal government smaller than Kennedy and the Democrats would be inclined to do, Nixon would spend less over-all than Kennedy, and again would tend to concentrate on areas of special importance in the area of national security. He would spend more than Kennedy, proportionately, on support for the gifted student as opposed to the average student; more, again proportionately, on aid at the college and post-graduate levels as opposed to aid to the public school systems.

In absolute terms, he may well be inclined to spend as much, or nearly as much, money as Kennedy on aid to the most promising students, but it is probably politically impossible to do a great deal for the gifted student while ignoring the average student. A big aid program for scientific education therefore implies at least a moderately big program of general aid to education.

Nixon vigorously supports federal aid to school construction, but not aid for teachers' salaries, although he has hedged a little on this by saying he is opposed to "direct" aid to salaries, which seems to leave open the possibility of indirect aid. Like Kennedy, he supports a greatly expanded federal student loan and scholarship program, and expansion of programs to help colleges build not only dormitories, as presently authorized, but laboratories and other non-revenue-producing buildings as well. On the other hand, he rejects the Democrats' belief that the federal government should accept continuing responsibility for the public

school system. He says that the responsibility is and should be with local government, that the federal government should back only limited term programs—to meet, for example, the present classroom shortage—and that this aid should be distributed primarily on the basis of need.

Whatever Kennedy's private feelings, as the Democratic candidate he is obligated to support both a very big program and a program that pays a good deal of attention to general social welfare. Like Kennedy, Nixon has certain party commitments, and as a Republican the most important of these is to avoid a very fast rise in the level of federal spending. This means that Nixon would probably be unable, although perhaps not unwilling, to back as big education and scientific research programs as the Democrats. But with all this, the difference between Nixon and Kennedy is probably less in the fields of education and science than in most other areas.

#### Nixon's Staff

Nixon's staff, like Kennedy's, tends to be made up of younger men with some of the key figures in their thirties, hardly anyone in his fifties. Like Kennedy's people, those concerned with policy are plainly well educated and smart. There are fewer professors than are closely associated with Kennedy, and the lawyers, who tend to make up the hard core of most political staffs, are more likely to be from Wall Street than from the faculty of Harvard Law School. But the contrast between Nixon and Eisenhower is sharper than that between Nixon and Kennedy.

There is comparatively little representation in the group around Nixon of the corporation presidents and board chairmen that Eisenhower has always chosen as his closest companions. There are many more, whether from the universities or outside, who might properly be tagged intellectuals. His full-time staff includes two professors of government (Charles Lichenstein of Notre Dame and George Grassmuck of Michigan) and Stanley McCaffery, vice president of the University of California. But there is no Nixon brain trust in the sense that there is a Kennedy brain trust: there is no one in Nixon's circle who gives the impression of having as strong a say on policy matters as some of Kennedy's associates, such as Archibald Cox on labor and J. Kenneth Galbraith on over-all economic policy.

#### Nixon and the Presidency

There is the clear assumption in both the Kennedy and the Nixon camps that the next president, whoever it is, must be a far more active, vigorous leader than Eisenhower has been. Both share the view, held by almost everyone in Washington, including at least some of the members of Eisenhower's own staff, that the most obvious shortcoming of the Eisenhower administration has been the lack of vigorous leadership at the presidential level.

Yet Nixon's conception of active presidential leadership contrasts sharply with Kennedy's (and with Rockefeller's). Like the absence in his organization of the sort of brain trust associated with Kennedy or Rockefeller, his conception of the presidency presumably reflects the Vice President's basic attitudes.

Kennedy and Rockefeller, both admirers of Franklin Roosevelt, see the presidency as the place of *national* leadership; that is, as an office which can be used to alter substantially the outlook and attitudes of American society. Nixon's attitude appears to be quite different. He does not, like Kennedy or Rockefeller, feel the need for something like another New Deal. The weaknesses he sees in the Eisenhower administration seem to be less a matter of its pursuing wrong basic policies than of its failure to push its generally correct policies with sufficient vigor. He sees the role of the presidency more in terms of vigorous leadership within his administration and within his party than Kennedy and Rockefeller do. Although unquestionably a representative of the liberal wing of his party, Nixon is a conservative by contrast with Kennedy or Rockefeller. He is a man ready to spend more money than Eisenhower, and he is less concerned with a balanced budget. But he is in no rush to introduce a wave of big new programs especially if, as such programs usually do, they add up to a really substantial increase in the federal budget and require substantial tax increases.

This attitude suggests why there is no Nixon brain trust: His self-described position as a "progressive conservative" is, by the standards of his party, much more progressive than conservative. But he remains a man, so far as he has allowed his feelings to be known, who seems basically satisfied with present policies, or with an expansion and development of present policies. He does not feel a great need to put people to

work as a brain trust to think up new programs he does not believe are necessary, or to develop proposals for greatly expanding the influence of the federal government, which he would oppose as an undesirable trend. He quite naturally, as noted above, sees the need for a man in the presidency who can work within his party and his administration for a more vigorous prosecution of accepted policies rather than the need Kennedy sees for a broader appeal to win support for policies which are new, not accepted, and indeed certain to encounter violent opposition.

#### Nixon and the Intellectuals

Nixon's relationship with the academic world is affected, of course, by the simple fact that the bulk of the academic people who would be most useful in the campaign are cut off from him. One of the best known intellectual figures associated with the Eisenhower administration estimates that at least 80 percent or more of the country's better known historians and economists are Democrats. The proportion of Democrats among the best known law professors and scientists is probably lower, but not too far behind. The fields in which the Republicans command the bulk of the academic support, notably among the faculties of engineering and business schools, are fields which are less pertinent to the needs of a candidate for policy advisers and speech writers.

Yet Nixon's academic support is far from insignificant. Next week the organization of a committee of intellectuals for Nixon will be announced, probably to be headed by Arthur F. Burns, president of the National Bureau of Economic Research and Eisenhower's former economic adviser; Lon Fuller, under whom Nixon studied at the Duke University Law School and now professor of jurisprudence at Harvard Law School; and George Berry, dean of the Harvard School of Medicine. Others closely associated with Nixon are William Yandell Elliott, chairman of the Harvard department of government, who accompanied Nixon on his trip to Russia; physicist Joseph Kaplan of UCLA, who was chairman of the International Geophysical Year program, an adviser in scientific matters; and Raymond Sauvion, chairman of the Council of Economic Advisers. But, impressive as this partial list may be, it defines a comparatively small group compared with the long list of national-

ly known academic figures who have publicly associated themselves with the Democrats.

The Republicans, naturally, would like to avoid the impression that all the brains of the country are for the Democrats. In 1956 they organized CASE, the Committee of the Arts and Sciences for Eisenhower, but its list of names tended to be dominated, so far as publicity value was concerned, by Irene Dunne and Adolph Menjou. The Republicans, in the new committee, will avoid a repetition of this. The effort will be to show that the thinking men can support Nixon, and the Hollywood stars, this year, will not be on the list. Another step has been the encouragement by the Nixon staff of the *Saturday Evening Post*, which supports Nixon, in its plans for an article on Nixon's intellectual support.

Formal committees of intellectuals, whether they are formed by the Democrats or the Republicans, are created almost entirely for their publicity value. Beyond this, Nixon has been working to establish relationships with people who can be useful as policy advisers, researchers, and speech writers. Nixon and his staff say that he has been his own speech writer and his own policy maker, and they suggest that in general Nixon is his own man more than Kennedy, who has relied more on outside help for speeches and ideas. Yet as the campaign develops Nixon too will have to rely more on outside help. He needs to talk about more things than he can have first-hand knowledge of. As Adlai Stevenson discovered, a politician simply doesn't have time to write all the speeches he needs for a campaign if he is to have enough time and energy to deliver them. Thus James Shepley, Time-Life's chief of correspondents, who has taken leave to join Nixon's staff, has lately undertaken a role somewhat similar to that of Ted Sorenson in the Kennedy camp. Like Sorenson he has been active in establishing initial contact with intellectuals who might be useful in the campaign. Such contacts, if successful, are likely to lead to an invitation to attend one of the Sunday afternoon talk sessions the Vice-President has been holding with people whose ideas and insights promise to be valuable.

Nixon's comparative lack of access to top academic people is balanced by the ready access that he, as Vice-President, has to people within the Administration. He has apparently made good

use of, and been influenced by, his contacts with such liberal-minded members of the cabinet as Labor Secretary Mitchell and Attorney General Rogers, as well as with a number of officials, some appointed, some career civil service, below the cabinet rank. Mitchell, for example, is believed to have influenced Nixon's stand in opposition to the so-called right-to-work laws, and Rogers is believed to be partially responsible for Nixon's strong commitments on civil rights.

#### Politics and Brain Trusts

People close to Nixon describe him as a "brainpicker": a man who is eager to talk to anyone who might have useful knowledge or ideas, but whose policies are clearly his own, rather than those of his advisers. They see a sharp contrast in this compared to Kennedy, and there is certainly a difference between the two. As was noted above, no one around Nixon gives the impression of having as strong a say on policy questions as some of Kennedy's associates. Whether this represents any weakness in Kennedy or special strength in Nixon is open to question. It may be that in reaction to Eisenhower's tendency to delegate his powers Nixon tries to control things more tightly than it is really efficient for one man to do. It is also true, as noted earlier, that Nixon, being more conservative than Kennedy, does not feel a similar need for a brain trust to help explore new policies for him.

There is nevertheless a sense of regret in the Nixon camp that the bulk of the best known academic names are on the other side. Because of the difference in outlook, they may not be sorry that Galbraith and Schlesinger are against Nixon, but they are certainly sorry that there are not more Burnses and Fullers to be for Nixon. But the Nixon people hope to turn the Kennedy brain trust to their own advantage. Nixon and other top Republicans have already started expressing their dismay that the party of Woodrow Wilson and Roosevelt should have become the party of Galbraith and Schlesinger and Bowles. There is actually a good deal of mutual respect between the two camps. But as the Democrats will, for campaign purposes, attempt to belittle Nixon in comparison with Eisenhower, so the Republicans will attempt to picture Kennedy as an immature young man whose administration would be dominated by his radical advisers.—H.M.

#### Morse Appointed to "Science" Editorial Board

It is a pleasure to announce the appointment of the distinguished research physicist Philip McCord Morse to the editorial board of *Science*. After graduation from the Case School of Applied Science (now the Case Institute of Technology), Morse took his master's and doctoral degrees at Princeton University. He continued at Princeton as an instructor in 1929-30. In 1930-31 he was a Rockefeller international fellow for study in Munich with Arnold Sommerfeld and at Cambridge with N. F. Mott and H. W. S. Massey. Upon his return to the United States in 1932 he became an assistant professor of physics at Massachusetts Institute of Technology, where he has continued his career except for leaves of absence for special tasks during and after World War II. He became an associate professor in 1934, a professor in 1937, and director of the MIT Computation Center in 1956. He continues to hold this last post and, in addition, is director of the MIT Operations Research Center, a position which he assumed in 1958.

Morse's early researches were divided between the field of the quantum mechanics of atomic collisions, with applications to gas discharges, and the field of acoustics. Later he became interested in operations research (see below) and computation. His most recent research work has been on electronic wave functions in metallic crystals and on linear acoustic theory. To some extent his range of research interests is reflected in the books or monographs he has authored or coauthored: *Quantum Mechanics* (with E. U. Condon), 1929; *Vibration and Sound*, 1936 (revised edition, 1946); *Methods of Operational Research* (with G. E. Kimball), 1950; *Methods of Theoretical Physics*, 1953; and *Queues, Inventories, and Maintenance*, 1958.

Morse has served the nation in numerous administrative and organizing capacities. After a brief stint at the Radiation Laboratory at MIT in 1939, he became chairman of a committee that was set up by the National Research Council to determine means of sound control and ways to reduce noise and vibration in military aircraft. He continued in this post until 1944 but also was pressed into service from 1939 to 1942 as director of a Navy project, which was administered by the National Defense Research Council, directed to



Philip McCord Morse

the discovery of means to counter acoustic mines. In 1942 he resigned from this post to accept an invitation to organize and become director of the U. S. Navy Operations Research Group, whose initial task was to counter the German submarine threat. He continued in this activity till the end of the war in 1945. One of the three volumes describing the work of the group—written jointly by Morse and G. E. Kimball and mentioned above—was released from classification and published in 1950.

In the spring of 1946 Morse was asked to organize and direct the nuclear research laboratory at Upton, Long Island, which was to become the Brookhaven National Laboratory. He continued in this post until the fall of 1948, when he returned to MIT in the hope of resuming his teaching and research, but he was again called upon to serve the government. James Forrestal, Secretary of Defense, prevailed upon Morse to organize and to be the first director of research for the Weapons Systems Evaluation Group. He returned to MIT in the fall of 1950 and has remained in residence since.

He has held numerous additional positions of trust and responsibility. He is currently a member of the board of trustees of the Rand Corporation and the council of the American Physical Society and has been on the board of trustees of the Institute for Defense Analyses and of the American Institute of Physics.

He is a member of the National Academy of Sciences, the American Acad-

emy of Arts and Sciences, the American Physical Society, the American Acoustical Society (president in 1948), and the Operations Research Society of America (president in 1952) and is a fellow of the American Association for the Advancement of Science.

His most recent extramural assignment has been to organize and direct the Panel on Operations Research of the North Atlantic Treaty Organization.

In addition to the honors already mentioned or implied above, Morse was awarded the D.Sc. degree by Case Institute of Technology in 1940 and the U.S. Medal of Merit for his work in operations research in 1946.

Morse has had varied experience in editorial functions. He is currently a member of the editorial board of *Physics Today* and is on the advisory board of the *Bulletin of Atomic Scientists*. He was associate editor of MIT's magazine, *Technology Review*, from 1936 to 1946 and has been editor of *Annals of Physics* since it was founded in 1957.

We are glad to welcome Dr. Morse to our editorial board.—G.D.U.S.

## News Notes

### News Briefs

**Basic research conference.** Progress in basic research in areas ranging from anatomy to nuclear energy will be considered in Seattle on 15 August by nine leading American scientists who will take part in a day-long program marking the dedication of the new \$2,250,000 Boeing Scientific Research Laboratories in Seattle. "Frontiers of Basic Research" will be explored in the morning program. The participants will be Walter O. Roberts, director of the High Altitude Observatory at Boulder, Colorado; Glenn T. Seaborg, professor of chemistry and chancellor of the University of California at Berkeley, and John C. Fisher, of the General Electric Research Laboratory in Schenectady, N.Y. Brief talks by six other scientists and a panel discussion of other areas of basic research will highlight the afternoon program.

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**Marine laboratories.** The North American section of the Directory of Marine and Freshwater Biological Laboratories of the World, is near completion. Directors of such laboratories who have not received the brief ques-

tionnaire issued by the international committee in charge of the preparation of the directory should write immediately to the editor, Professor Robert W. Hiatt of the University of Hawaii. The committee hopes to make the directory as useful as possible, and requests the cooperation of laboratory directors in calling attention to institutions inadvertently overlooked.

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**Canada-India reactor.** The Canada-India reactor went into operation last month at Trombay, India, according to a recent announcement by India's Atomic Energy Commission and the Atomic Energy of Canada Limited. The start-up of the research and engineering test reactor, which is a modified version of the NRU reactor at Chalk River, Canada, climaxes 5 years of close cooperation between engineers, scientists, and technicians of the two nations.

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**New medical school.** A "regional" school of basic medical sciences is to be established at the University of New Mexico. A \$1,082,300 grant from the W. K. Kellogg Foundation will assist the university over a 5-year period to establish a school covering the first 2 years of the medical curriculum. About half of the grant will be spent to meet, in part, the planning and operating costs for the school's first 5 years, and the other half will be used for construction of facilities on the Albuquerque campus.

Other Western states—Arizona, California, Hawaii, Idaho, and Montana—also are taking new steps to meet their medical education needs.

### Grants, Fellowships, and Awards

**Arthritis and rheumatism.** The Arthritis and Rheumatism Foundation offers predoctoral, postdoctoral, and senior investigatorship awards in the fundamental sciences related to arthritis for work beginning 1 July 1961. Deadline for applications is 31 October. These awards are intended as fellowships to advance the training of young men and women of promise for an investigative or teaching career. They are not in the nature of a grant-in-aid in support of a research project. Stipends range from \$2000 to \$10,000 per year. For further information and application forms, address the Medical Director, Arthritis and Rheumatism Foundation, 10 Columbus Circle, New York 19, N.Y.

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**Cardiovascular research.** Men and women with doctor's degrees who are interested in conducting cardiovascular research at Central Ohio institutions have until 15 September to apply for fellowships with the Central Ohio Heart Association. Applicants must have served at least a year of internship or the equivalent. In exceptional cases, a fellowship may be awarded to an individual with a bachelor's or master's degree who has shown unusual promise. Qualified nonmedical personnel will be given equal consideration, provided their projects are related to cardiology. Both clinical and basic-science fellowships will be awarded, for a period of 1 year at annual stipends ranging from \$2800 to \$8000. Requests for application forms should be directed to the Central Ohio Heart Association, 145 North High Street, Columbus 15, Ohio.

**Life sciences.** The Division of Biological and Medical Sciences of the National Science Foundation announces that the next closing date for receipt of basic research proposals in the life sciences is 15 September. Proposals will be reviewed at the fall meetings of the foundation's advisory panels, and disposition will be made approximately 4 months after the closing date. Proposals received later than 15 September will be reviewed after the spring closing date of 15 January 1961. Inquiries should be addressed to the National Science Foundation, Washington 25, D.C.

**Reproduction.** In recognition of the world-wide need for scientific training in reproductive physiology, the Worcester Foundation for Experimental Biology plans to initiate, on 1 January 1961, a postdoctoral program in this field under a grant from the Population Council. Fellowships for the program will be awarded to candidates possessing the Ph.D. or M.D. or their equivalents. These fellowships will carry a stipend of \$5500 per annum and will be for a 12-month period. An allotment will also be made for round-trip travel to the foundation headquarters. Application blanks may be secured from the Research Director, Worcester Foundation for Experimental Biology, Shrewsbury, Mass., and should be returned at an early date. The fellowship awards for the first year will be announced late in 1960. Applicants for participation in the program in 1962 and later years may communicate with the director at any time, but their applications will not be acted upon in 1960.

## Scientists in the News

At a recent ceremony to mark the 300th anniversary of the founding of the Royal Society of London, the Queen Mother, chancellor of the University of London, presented honorary degrees to the King of Sweden, Detlev W. Bronk of the United States, Homi J. Bhabha of India, Sir Macfarlane Burnet of Australia, George Charles de Hevesy of Sweden, and Sir Thomas Merton of England.

The following scientists from the United States were among those who received honorary degrees at the recent 500th anniversary celebration of the University of Basel, Switzerland: Emil Witschi of the State University of Iowa, Ray Herb of the University of Wisconsin, and Kenneth Thiman of Harvard University.

**Otto Struve**, director of the National Radio Astronomy Observatory, received an honorary degree from the University of Kiel, Germany, on 8 July. A month earlier he also received an honorary degree from Wesleyan University, Middletown, Conn.

The National Academy of Sciences-National Research Council has announced the appointment of new chairmen to four of the academy's eight divisions. The appointments are for 2 years.

**Edward P. Espenshade, Jr.**, chairman of the department of geography at Northwestern University, is chairman of the Division of Earth Sciences. He succeeds John N. Adkins, director of the earth sciences division, Office of Naval Research.

**Emil W. Haury**, professor and head of the department of anthropology at the University of Arizona, is chairman of the Division of Anthropology and Psychology. He succeeds Neal E. Miller, James Rowland Angell professor of psychology at Yale University.

**J. Barker Rosser**, professor of mathematics at Cornell University, is chairman of the Mathematics Division. He succeeds **Samuel S. Wilks**, professor of mathematical statistics at Princeton University.

**Robert C. Elderfield**, professor of chemistry at the University of Michigan, is chairman of the Division of Chemistry and Chemical Technology. He succeeds **Ernest H. Volwiler**, president of Abbott Laboratories, North Chicago, Ill.

**Harriet B. Creighton**, professor of botany at Wellesley College and secretary of AAAS Section G-Botanical Sciences, has just returned from a year as Fulbright lecturer in genetics at the University of Cuzco, Cuzco, Peru.

**Jacques Van Mieghem** of Brussels University (Belgium) has received the International Meteorological Organization Prize, which is awarded for outstanding work in meteorology and in international collaboration. Van Mieghem has published many papers, particularly on the general circulation and thermodynamics of the atmosphere and on energy transfer in large atmospheric disturbances.

His contribution to international coordination of research in meteorology is considerable. He was elected in 1951 as president of the Commission of Aerology of the World Meteorological Organization and was designated by WMO as its representative on the Special Committee of the International Geophysical Year. He represented the organization at various international scientific meetings. Further, he served as secretary and subsequently as president of the International Association for Meteorology and Atmospheric Physics of the International Union for Geodesy and Geophysics.

**S. E. Gould**, professor of pathology, Wayne State University College of Medicine, and pathologist, Wayne County General Hospital, Eloise, Mich., has been invited by the Polish Academy of Sciences to serve as representative from the United States to the first International Conference on Trichinosis, to be held in Warsaw on 12 and 13 September. The conference will observe the 100th anniversary of Zenker's discovery of *Trichinella spiralis* as the causative agent of trichinosis.

**J. B. Adams**, acting director-general of the European Organization for Nuclear Research (CERN) and director of CERN's proton synchrotron division, has been awarded the Roentgen Prize by the Justus Liebig University of Giessen (Germany).

Presentation of the prize was made on 1 July during a ceremony in commemoration of the 350th anniversary of the university, whose Physical Institute was headed by Wilhelm K. Roentgen until 1885. The award will be given annually for outstanding contributions in fundamental research in particle physics.

**Alfred H. Washburn** has resigned as director of the Child Research Council, University of Colorado School of Medicine, effective 1 October. He will remain an active member of the research staff of the institute, participating in its studies of the development of individuals throughout their life span.

Washburn is succeeded by **Robert W. McCammon**, who has been with the Child Research Council since 1949, first as assistant and then as associate director.

**Thomas W. Kethley**, of the staff of the Engineering Experiment Station, Georgia Institute of Technology, has been appointed research professor of applied biology and head of the newly formed Bioengineering Branch.

This fall **Robert S. Ingols**, at present professor and head of the institute's department of applied biology, will become director of the new School of Applied Biology, which will offer undergraduate and graduate degrees in the fields of experimental and applied biology.

**C. M. Pomerat**, professor of cytology and director of the tissue-culture laboratory of the Medical Branch, University of Texas, has been appointed director of biological research at the Pasadena Foundation for Medical Research, Pasadena, Calif. He has also accepted appointments to serve as adjunct professor of anatomy at the School of Medicine, University of Southern California, and clinical professor of pathology at the College of Medical Evangelists in Los Angeles.

**William G. McGinnies**, director of the Central States Forest Experiment Station, Columbus, Ohio, for the past 6 years, has been appointed director of the Tree Ring Laboratory and coordinator of the Arid Land Research Program at the University of Arizona in Tucson. Retiring from the U.S. Forest Service after 30 years in research, McGinnies assumed his new duties on 1 August.

As director of the Tree Ring Laboratory he will carry forward and expand investigations correlating tree growth and weather. The Arid Zone Program, administered by the University of Arizona and sponsored by the Rockefeller Foundation, is part of a worldwide project of the United Nations Educational, Scientific, and Cultural Organization and is devoted to finding new and better ways to use arid land.

**Robert S. Mulliken**, Ernest De Witt Burton professor in the physics department of the University of Chicago, has recently received several honors. In February he was presented with the Gilbert Newton Lewis Medal of the California Section of the American Chemical Society "for achievement in theoretical aspects of chemistry." In May he received the Theodore William Richards Medal of the Northeastern Section of the ACS "for conspicuous achievement in chemistry." During the spring he spent 5 weeks at Cornell University as George Fisher Baker non-resident lecturer in chemistry, where he discussed the interaction of electron donors and acceptors.

**Hans Meier** of the Children's Cancer Research Foundation, Boston, has been appointed a staff member at the Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Me.

**Albert J. Rohlfs**, meteorologist on the Pacific Weather Project, has recently been transferred from Honolulu to the U.S. Weather Bureau's marine center at New Orleans, where he has been appointed marine meteorological assistant to George L. Canaday, marine meteorological supervisor for the Gulf of Mexico, the Caribbean Sea, and West Indian waters.

**Joseph H. Gerber** has been named director of the Center for Aging Research of the National Institutes of Health. He was formerly medical officer in charge of the Public Health Service's Indian Health Area Office, Aberdeen, S.D. He succeeded **G. Halsey Hunt**, who is now chief of the Division of General Medical Sciences.

## Recent Deaths

**Harlan H. Barrows**, Chicago, Ill.; 83; professor of geography at the University of Chicago and coauthor of widely used textbooks; June.

**Saul R. Buc**, New York; 45; research fellow at the Central Research Laboratories, General Aniline and Film Corporation, Easton, Pa.; 5 June.

**Bernard H. Dawson**, La Plata, Argentina; 69; astronomer associated with the National University Observatory, La Plata, since 1912; specialist in variables, double stars; discoverer of Nova Puppis, 1942; president of the professional astronomers' group of Argentina; 18 June.

**Vernor C. Finch**, Madison, Wis.; 77; for many years a professor of geography at the University of Wisconsin; co-author of *Geography of World Agriculture*, published by the U.S. Government, and of two widely used college textbooks; 23 October 1959.

**Brenton R. Lutz**, Melrose, Mass.; 70; emeritus professor of biology and formerly department chairman at Boston University (1928-1956); noted for his work on the evolution of the carotid sinus reflex and on respiration and circulation in fishes, and, more recently, for research on the physiology of small blood vessels by means of micromanipulative and cineradiographic procedures; 22 June.

**Franz Marschall**, Easton, Pa.; 62; for 25 years research chemist at the Central Research Laboratories of General Aniline & Film Corporation; 20 May.

**Walter B. Pillsbury**, Ann Arbor, Mich.; 87; professor emeritus and former chairman of the department of psychology at the University of Michigan; 3 June.

**Norman L. Schmidt**, Stamford, Conn.; 63; urologist who practiced in New York and Stamford; was a special fellow in oncology and a research associate in cancer at the Yale University School of Medicine; 20 July.

**Frank E. Williams**, Phoenix, Ariz.; 83; professor emeritus of geography at the University of Pennsylvania's Wharton School of Finance and Commerce; 9 July.

*Erratum:* The meeting of the American Institute of Biological Sciences (28 Aug.-1 Sept.) will be held at Stillwater, Okla., and not at Norman, Okla., as incorrectly indicated in the 22 and 29 July issues.

*Erratum.* The note that announces E. L. Reynolds' visiting appointment to Hiroshima Women's College [Science 132, 213 (22 July 1960)] indicates that Reynolds is a member of the staff of the Fels Research Institute, when in fact he has not been actively associated with the institute for a decade. During the past 10 years he has been employed by the Atomic Energy Casualty Commission in Japan and self-employed as a freelance author and lecturer and owner-navigator of the yacht *Phoenix*.

*Erratum.* In the report "Reversible inhibition of beef heart cytochrome *c* oxidase by polyionic macromolecules" by P. Person and A. Fine [Science 132, 43 (1960)], it is incorrectly stated in the next-to-last sentence in the legend of Fig. 2 that protamine sulfate (final concentration 33  $\mu$ g/ml) was added to the cuvette. Polyglucosamine sulfate, rather than protamine sulfate, was added.

*Erratum.* In the report "Complementation at the maroon-like eye-color locus of *Drosophila melanogaster*" by E. Glassman and W. Pinkerton [Science 131, 1810 (1960)], the genetic designations of the stocks used in the work (given near the top of column 1, page 1811) were made unclear by our insertion of explanations for the symbols *v* and *f* in the designation. The sentence should have read "The stocks used were *v*/*f* *Bx<sup>a</sup>* *ma<sup>-1</sup>*, which was made from the *ma<sup>-1</sup>* strain at California Institute of Technology, and *v* *ma<sup>-1</sup>*, which was made from the *br* stock kindly made available by Fahmy." (*v*, vermilion eye color; *f*, forked bristle; *Bx<sup>a</sup>*, Beadex wing; *ma<sup>-1</sup>*, maroon-like eye color; *ma<sup>-1</sup>*, bronyz allele of maroon-like eye color)

## Book Reviews

**Automatic Language Translation.** Lexical and technical aspects, with particular reference to Russian. Anthony G. Oettinger. Harvard University Press, Cambridge, Mass., 1960. xix + 380 pp. Illus. \$10.

**Automatic Translation.** D. Yu. Panov. Translated from the Russian by R. Kisch. A. J. Mitchell, Ed. Pergamon Press, New York, 1960. viii + 73 pp. \$3.50.

Translation by machine, in order to present a passable product, must incorporate at least a partial solution to the two basic problems of selection and arrangement: namely, the selection of the correct equivalent from among several possible alternatives presented by a bilingual dictionary, and the rearrangement of the translated elements whenever there is a variance between the word order found in the original sentence and the word order required in the translation for an intelligible rendition of the content of the original. Semantics, which, very roughly speaking, deals with selection problems, and syntax, which, among other things, deals with rearrangement, have emerged as the two crucial (though overlapping) problem areas in the machine translation field. Neither of the books under review deals in a substantive way with either problem (nor does either pretend to do so), although both acknowledge the importance of the problems. The two books are quite dissimilar, titles and chapter headings to the contrary notwithstanding.

*Automatic Language Translation*, by Oettinger, is a serious, well-written account of a specific project of the Harvard Computation Laboratory. The author treats exhaustively a very limited aspect of the subject of machine translation; some good discussion of computer programming and data processing is included. *Automatic Translation*, by Panov, touches upon a broad spectrum of machine translation problems but, in effect, is little more

than a superficial account of the early (1955-56) work in this field at the Institute of Precision Mechanics and Computer Engineering (Moscow), plus some brief description of a few subsequent lines of investigation.

Oettinger's book can usefully be looked upon as containing two major packages. Chapters 1 and 3 present a quite good introductory account of computer programming and data processing, but the material is more appropriate for the specialist or the student than for the layman. Section 1.6 in particular should serve to illuminate a number of often confused questions concerning random versus sequential access. The second major package, beginning with chapter 5, is a detailed account of the methods, procedures, and results of the Harvard "automatic dictionary" project at the time the book was written. This project was then primarily concerned with problems of dictionary maintenance and lookup, and with those aspects of morphology represented by the stem-affix splitting procedures necessary in automatic translation. Other solutions to the problem of word inflection through stem-affix splitting have been developed and presented in the literature, but nowhere else (other than in several progress reports made by that same project to the National Science Foundation) can so exhaustive a treatment of a specific method be found. The Harvard book will probably be of particular interest to workers in the field of machine translation or in related fields involving the processing of language data, if such workers wish to establish or develop a well-organized discipline of computer procedures associated with dictionary lookup and problems of word inflection. Even these readers must be cautioned that Oettinger has not concerned himself with the efficiency or the speed of computer usage, and other works in the literature may be consulted to find ingenious and efficient dictionary lookup procedures for general-purpose computers. Although Oettinger exhibits

his usual eloquent command of English and, for the most part, the book is easily read, one suspects that had he occasionally substituted natural language for some of the mathematics and, perhaps, exploited a few golden opportunities to omit detail, the interests of digestibility would have been better served.

Most portions of *Automatic Translation* by Panov can be identified in literature dating back to 1956. A pamphlet published in Moscow in 1956 by the Academy of Sciences of the U.S.S.R. (*An Experiment of the Machine Translation of Languages Carried out on the BESM*, by I. S. Mukhin) is largely represented in sections 1, 5, and 6 of the Panov book. Section 7 is carried over from an earlier (1956) Moscow book published in English (November 1958) by the U.S. Joint Publications Research Service (JPRS/DC-379). The rest of the book, Sections 8 through 11, was published (January 1959) by the U.S. Joint Publications Research Service (JPRS/DC-487D). Sections 2, 3, and 4 are apparently new and attempt to give the layman an intuitive impression of the processes performed by a human translator and of how these processes might reasonably be mechanized. This treatment is quite brief, falls well short of the mark, and is of little interest.

In the last several years a rather large quantity of Russian publications in the field of machine translation have been made available in English (and on a timely basis) by the U.S. Joint Publications Research Service. Much of this material is quite good, very informative, and reflects a large-scale, serious effort on the part of the U.S.S.R. in the field of machine translation. The Panov book, however, in no way approaches a comprehensive account of even the early Russian work. It is, to a large degree, based on the 1955-56 experiments with the BESM computer but, even on this subject, is fragmentary. From these experiments a number of examples are given of machine translation of English into Russian; if taken at face value these examples exhibit a highly advanced machine translation capability well beyond that which has been, at this time, legitimately demonstrated anywhere else. Curiously enough, even though most of these examples have been available for inspection for several years, the inexplicably high quality illustrated has not before been commented upon, to our knowledge. (Especially sophisticated is an example from Dickens' *David Copper-*

field, though in all examples the implication is given that all multiple meaning problems have been resolved!) The rules for translation outlined in the Panov book and, for that matter, the rules presented elsewhere in the Russian literature do not even begin to explain how the sample translations could have been achieved. Since no other evidence to date supports the hypothesis that the Russians in 1956 were ahead of where the rest of the world is now, it seems reasonable to infer that the translation samples shown probably represent text that was studied beforehand in order to develop rules, the applicability of which was guaranteed by such prior analysis. The foregoing inference may not be justified but, in the absence of a detailed exposition of all rules used, it is difficult to conclude otherwise. (We of course assume that neither the original English text nor the final machine output of Russian text was in any way subjected to human editing.) Any thoughtful scientist will recognize that a sensationally elegant machine translation of a limited and specific body of text can be produced on the basis of prior study of that text by essentially anyone with a small amount of ingenuity plus the ability to program a general purpose computer. The only matter of real interest then lies in the question of the general validity of the rules when applied to text other than that used as a basis for developing the rules.

Chapter 10 of Panov's book contains a few pages of gratifying discussion, much more indicative than is the rest of the book of the depth and nature of the problems of machine translation. It is pointed out that machine translation is not solvable in a formal or mathematical sense, as is, for example, the problem of code breaking. Panov justifiably criticizes Weaver's analogy between machine translation and code breaking and points out briefly a few of the essential and profound differences between the two.

With all its shortcomings, the book by Panov should be of some casual interest to the layman for its presentation of an introductory, though quite superficial, account of the nature of an automatic translation process.

The field of automatic translation still awaits a book which presents the subject adequately and informatively to the scientific community.

PAUL L. GARVIN

DON R. SWANSON

Ramo-Wooldridge Laboratories,  
Canoga Park, California

**Cochiti.** A New Mexico pueblo, past and present. Charles H. Lange. University of Texas Press, Austin, 1960. xxv + 618 pp. Illus. \$10.

The Pueblo Indians of the Rio Grande are visited by thousands of tourists every year and have been known to history ever since their discovery by Coronado in 1540. But Spanish attempts to obliterate their native religion in the process of Christianization led to the erection of a wall of secrecy, and until very recently little has been known of their inner life. Charles Lange's monograph on Cochiti, the first comprehensive account of the culture of a Rio Grande Keresan-speaking pueblo, will therefore be of great interest to all students of the Southwest.

We know from the archeological record that the Keres moved into the Rio Grande region from the west in the 13th century and formed a wedge among the Tanoan-speaking pueblos in the present vicinity of Santa Fe, N.M. In addition to mutual interaction and cultural exchange, all of these pueblos have been subjected to the impact of Spanish and, later, American culture over a period of some 4 centuries. For Cochiti there are only a few accounts from the Spanish period, but within the last century important observations have been made by a number of scholars, including Bandelier, Starr, Goldfrank, Benedict, Parsons, and Boas.

Lange has built his account, in part, on the work of his predecessors, but the bulk of his materials comes from his own researches covering the period 1946-53 and including three summers' residence in the pueblo with his family. He presents a balanced and satisfying integration of modern pueblo life, in the perspective of the last hundred years. On the other hand, comparative discussion is held to a minimum, in part because of the lack of comparable data from many of the eastern pueblos.

The volume is organized in terms of geography, history, resources, economy, political organization, ceremonial organization, and the social system; 44 appendixes cover a wide range of statistical and other data. Of particular interest is Lange's discussion of the political system, including the "progressive" and "conservative" factions, and his detailed account of the ceremonial organization, including the Katsina cult. While Cochiti is the most progressive of the eastern Keresan pueblos, social and cultural change has been gradual enough to make the author hopeful for

the future. But whether the pueblos can maintain a social and ceremonial system, geared to community values, in the face of electric power, farm machinery, modern schooling, and a growing dependence on wage work remains to be seen.

The University of Texas Press has produced a handsome volume that should have a wide appeal. It is also a volume in which the data for the author's conclusions are fully presented. Here we can see the effects of 400 years of contact with Spanish and American cultures and can begin to understand the complexities of social and cultural change in a society with values that are quite different from our own.

FRED EGGAN

Department of Anthropology,  
University of Chicago

**Agriculture and Ecology in Africa.** A study of actual and potential development south of the Sahara. John Phillips. Praeger, New York, 1960. 412 pp. Illus. \$13.50.

This book, written by a man with special competence in agriculture, is intended for scholars of other disciplines and for administrators and others concerned with economic development in Africa.

John Phillips' subject, the landscapes of Africa and man's use of them for agriculture, is a complex matter for analysis and one of importance. The vast, essentially rural continent is impoverished. Real levels of living, as measured by per capita food and shelter inputs, are among the world's lowest. Most of the population is dependent on subsistence rather than on cash-crop agriculture. Productivity per acre is low, and land deterioration, a forerunner of further decrease in yields, is widespread. These are the reasons why this and other books on the subject are needed.

African lands have been tilled for some thousands of years by indigenous cultivators of root and grain crops, using systems of shifting cultivation. They have been worked by European land-use techniques for as much as three centuries. Since World War I, European agricultural officers in colonial territories have had widespread influence on land use by Africans. These officers have brought to the task experience and training gained in mid-latitude agriculture. In the mid-20th

century, neither the indigenous African systems nor the grafted-on European systems are suitable, or even adequate, to continue to provide food and other agricultural products for this continent with its increasing population.

Land-use systems and techniques appropriate to the diverse and largely tropical landscapes of Africa must be developed. This is one of Phillips' main arguments. Suitable techniques can be evolved only through intensive study of the relationships of the elements of climate, soils, and vegetation in the areas to be used. The extreme diversity of climate, soil, and vegetation associations must be recognized by persons concerned with agricultural development.

Among the problems posed by these factors in Africa, Phillips cites the high humidity of the rain forests and its role in furthering plant and animal disease. High evaporation in the semi-arid lands and its limiting effect on plant growth is treated. This problem, so important over the vast savanna lands, should have been handled in more extended fashion, if it is to be understood by the government officials to whom the book is largely directed. Diagrams showing monthly precipitation, potential evapotranspiration, and water balance for several stations would have clarified the matter.

Among the vegetation problems treated is that of the annual grass burning of the savannah areas, its influence on soil fertility, and its relationship to thicket encroachment.

In all of these problems the stress is on study of the ecology of areas small enough to be relatively homogeneous from the viewpoint of the agriculturalist. On the basis of association of climate and vegetation, Phillips tentatively categorizes Africa south of the Sahara into more than 40 type-regions. The regional divisions are shown on an adequate map. The climate, vegetation, and soils of each region are described in some detail, as are problems of tree crop, tillage agriculture, or livestock keeping when appropriate. Present land use is described, and a statement of Phillips' evaluation of possible future use is made for each region. This part is really a handbook, and it should be read selectively. Its readability is not enhanced by the continued use of symbols or abbreviations for elements of climate, severity of ecological factors, and variations in vegetation and so forth. In this section the author brings together much material

previously available only in the reports published by the various agricultural research stations and colonial departments of agriculture, and in a number of journals. This is an important contribution. By bringing together this information Phillips forces himself and us to re-examine our earlier generalizations about African land use, which were based on less comprehensive data.

The latter third of the book deals with other factors influencing agricultural development, such as human health, livestock disease, and present agricultural productivity. There is a discussion of the large development schemes including the Gezira cotton scheme in the Sudan, the groundnut scheme in Tanganyika, and the proposed Volta River scheme in Ghana. Phillips argues that large schemes should be undertaken only after extensive examination of the ecological problems of the area to be developed.

This book could only have been written by an agricultural scientist with extensive field experience in Africa and a wide acquaintance with the literature from the numerous agricultural research centers in Africa. It should be of service to scholars of other disciplines and to the political leaders of the emerging African states.

WALTER DESHLER

Department of Geography,  
University of Maryland

**Wave Propagation in a Random Medium.** Lev A. Chernov. Translated from the Russian by R. A. Silverman. McGraw-Hill, New York, 1960. viii + 168 pp. Illus. \$7.50.

This is the first more or less complete account, in English, of the theory of wave propagation in random media. The results are necessarily specialized to perturbation solutions of one kind or another since closed-form solutions of the equations are unattainable.

The many detailed calculations include solutions based on the ray theory, valid when the scale of inhomogeneities is large compared with the wavelength; first-order perturbation solutions of the wave equation; and the effects of fluctuations of the medium on the focusing properties of optical systems. Of special interest is a section on the deviation of rays treated by means of the Fokker-Planck equation, a technique developed by the Russian school. Many detailed results on the correla-

tion of fluctuations in the phase and amplitude of waves in inhomogeneous media are derived by means of a straightforward application of first-order perturbation solutions of the wave equation.

One chapter is devoted to experimental data; this is surely too little for adequately describing the wide range of potential applicability of this theory. Chernov mentions American contributions to the subject which were made up to around 1954, but there has not been much of outstanding interest published since that time. This book is at present the only one available in English on the subject, and it is a valuable account of a theory which is not widely taught in America.

GEORGE WEISS

Institute for Fluid Dynamics  
and Applied Mathematics,  
University of Maryland

**The Search for New Antibiotics.** G. F. Gause. Yale University Press, New Haven, Conn. 1960. 97 pp. Illus. \$4.75.

This book is the record of the "Trends in Science" lectures given at Yale University, in December 1959, by Professor G. F. Gause (Institute of Antibiotics, Moscow). It consists of three lectures. The first, on the distribution of antibiotic-producing microorganisms, presents Soviet evidence that there are a greater number and a greater variety of kinds of microorganisms in the soils of the South than in those of the North, and discusses the idea that geographic factors are a controlling determinant of the distribution of antibiotic-producing organisms. The second lecture emphasizes the importance of the early classification of any unknown microorganisms producing antibiotics as an index of the type of antibiotic it is producing. The argument is less firmly grounded than that for distribution, and reflects a prevalent opinion in the Soviet Union on a somewhat controversial position.

The third lecture is on the use of microorganisms in cancer research. It is first concerned with the problem of whether "equivalents" to cancer exist in microorganisms. Such equivalents are thought to be found in certain (but not all) respiratory-deficient mutants of yeasts, molds, bacteria, and protozoa; methods are described for obtaining the proper types. While this approach is

highly dependent upon the idea that the cancer is a cancer *because* of impaired respiration, Gause presents evidence that biological alkylating agents—actinomycin C, a new antibiotic "6270" having antitumor activity, 6-mercaptopurine and relatives—are much more active in inhibiting such respiratory-deficient strains than they are in inhibiting the parent strains. In short, evidence is presented that agents having antitumor activity inhibit the respiratory deficient strains without comparable inhibition of the parents, and that materials without antitumor activity inhibit both types of strains equally, if at all. Therefore, such mutants can be employed as detectors for potential antitumor agents.

The lectures are intelligently conceived, well organized, in excellent English, and attractively printed.

WAYNE W. UMBREIT

Department of Bacteriology,  
Rutgers University

**Die Natur im Weltbild der Wissenschaft.** Walter Hollitscher. Globus Verlag, Vienna, Austria, 1960. 499 pp. Illus.

This is a concise and well-rounded presentation of the fundamentals of natural science, written by a faithful Marxian for faithful Marxians. The book will also be interesting and useful to those non-Marxians who wish to study this perplexing phenomenon—Marxist science on this side of the Iron Curtain. Roughly the first quarter of the book gives an outline of the history of science; the second quarter is an account of physics, astronomy, and cosmology; the third presents the biological theories of evolution, heredity, and development; and the fourth deals with human evolution, Pavlovian psychology, and population problems. The tone of the book is set in the opening chapter by quotations from these great *scientific* authorities—Marx, Lenin, Mao Tse-Tung, and Engels. Marx and Engels are, indeed, the most frequently quoted authorities, followed by Lenin, Darwin, Haldane, Needham, Pavlov, and Ambarzumian.

The book is written interestingly and well; whether it presents an accurate and fair account of the topics with which it deals is a different question. I derived some wry amusement from the author's valiant but unsuccessful efforts to pay due homage to Michurinist biology without making himself

thoroughly ridiculous. The technique adopted is to say that recent developments in biology make the gene theory pretty much indistinguishable from the Michurin-Lysenko teachings. Both are misrepresented in the process. But, after all, the value of the book is in the light it throws on Marxist science, not on science in general.

THEODOSIUS DOBZHANSKY

Columbia University, New York, and  
University of Sydney, Sydney, Australia

**Frontiers of the Sea.** The story of oceanographic exploration. Robert C. Cowen. Doubleday, New York, 1960. 307 pp. Illus. \$4.95.

To cram a readable account of the oceans into 307 pages is a man-sized job, and Robert Cowen has handled it well. The publisher, or whoever is responsible for such things, let three typographical errors creep in, but for a book that sells for less than \$5 these days, one can be lenient and note such errors only in passing.

The book contains a concise history of oceanography and a report on nearly all major phases of work at sea: bathymetry, biology, currents, tides, and food, as well as an account of the most recent discoveries and developments (the author is very up to date). He has included 16 pages of excellent photographs; these are placed in groups of eight at intervals approximately one-third and two-thirds of the way through the book. Fifty-four line drawings by Mary Cowen add considerably to the book's charm. It is pleasant to see good hand sketches of currents, instruments, charts, fish, and plankton.

There is an introduction by Roger Revelle which is "up to snuff," endpaper charts at front and back, a briefly annotated bibliography listing 18 volumes that are well-worth reading, and what appears to be a good index (six and a fraction pages). I read the book rather carefully in about 6 hours.

There are a few statements or implications in the book which bear further discussion. Cowen states on page 74 that "much of the recent detailed data on undersea topography has been kept secret . . ." This was true until quite recently when the Navy's classification of bottom topography was brought up to date; this involved considerable declassification.

In his discussion of coral atolls, Cowen implies that the drillings on

Bikini and Eniwetok were connected with bomb tests. They were only in the following way—the Bikini drilling was part of a general resurvey made in 1947, one year after "Operation Crossroads"; the Eniwetok drilling was convenient because the impending H-bomb test made logistic support available. Both atolls were drilled primarily for scientific purposes.

On page 181 it is indicated that coal and oil might form in deep water, although I do not believe that implication is intended. These products are certainly formed in shallow water. Similarly, on page 212, it is indicated that the vertical migration of plankton has been studied for the last half century, but it seems to me that knowledge about this phenomenon is of recent origin.

In the brief treatment of recent international affairs in oceanography (in the eleventh and final chapter), Cowen states that the Special Committee on Oceanic Research (SCOR) is a Committee of the International Geophysical Union (more correctly the International Union of Geodesy and Geophysics, IUGG). This a mistake. SCOR is a creature of the International Council of Scientific Unions (ICSU) of which the IUGG is also a member. Representatives are sent to SCOR from IUGG and from several other scientific unions that are members of ICSU.

It would have been useful if, in the section on tides, Cowen had included the seasonal exchange of sea water between the northern and southern hemispheres. However, this recent discovery, further checked during the IGY, is still not fully understood and perhaps would be better discussed at a later date.

The general sense of the volume, that the oceans are simply waiting for us to utilize them fully, is good. In gradual, but ever-increasing tempo, many agencies of the federal government are emphasizing research and exploration at sea. It is an investment in the future which we cannot afford to miss and which, indeed, we are not going to miss. The value of the oceans is fully brought out in this book.

*Frontiers of the Sea* will be worthwhile reading for the interested and lay public, for whom it is intended. By keeping the public accurately informed, Cowen has given important help to those who must determine that the United States does not lag in its scientific development.

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## New Books

### Biological and Medical Sciences

Fleisch, Alfred. *New Methods of Studying Gaseous Exchange and Pulmonary Function*. Translated by Charles Corsi. Thomas, Springfield, Ill., 1960. 130 pp. \$5.75.

Greenberg, David M., and Harold A. Harper, Eds. *Enzymes in Health and Disease*. Thomas, Springfield, Ill., 1960. 475 pp. \$14.50. Papers (26) presented at the course organized at University of California Medical Center (San Francisco) in April 1959.

Haimowitz, Morris L., and Natalie Reader Haimowitz, Eds. *Human Development*. Crowell, New York, 1960. 813 pp.

Hardy, D. Elmo. *Insects of Hawaii*. vol. 10, Diptera: Nematocera—Brachycera. Univ. of Hawaii Press, Honolulu, 1960. 377 pp. \$7.

Harris, H. *Human Biochemical Genetics*. Cambridge Univ. Press, New York, 1959. 318 pp. \$7. A survey of human inherited metabolic abnormalities. In the foreword L. S. Penrose says "In presenting this well-balanced and learned account . . . Harris has done a valuable service to medicine, to biochemistry, and to genetics. . . . This book . . . can open a new world to [workers in these subjects]."

Harris, Robert S., and Harry Von Loescke, Eds. *Nutritional Evaluation of Food Processing*. Wiley, New York, 1960. 630 pp.

Jacquot, R., et al. *Nutrition animale*. vol. 2, pt. 2. Baillière, Paris, 1960. 490 pp. NF. 50. A volume in the *Nouvelle encyclopédie agricole*, Jean Lefèvre and Pierre Tissot, Eds.

Jámbor, Béla. *Tetrazoliumsalze in der Biologie*. Fischer, Jena, Germany, 1960. 163 pp. DM. 22.40.

Kelen, E. *Permeability in Acute Experimental Inflammatory Oedema*. In the light of the action of salicylates. Hungarian Acad. of Sciences, Budapest, 1960. 256 pp.

Lane-Petter, W., Ed. *Living Animal Material for Biological Research*. International Committee on Laboratory Animals, Carshalton, Surrey, England, 1960. 100 pp. \$3. Proceedings of a symposium organized by the International Committee on Laboratory Animals under the auspices of UNESCO during 1958. Contents include seven papers presented at the symposium, the Secretary-General's report, and a selection of the contributions to the discussion of papers.

Love, Albert G., Eugene L. Hamilton, and Ida Levin Hellman. *Tabulating Equipment and Army Medical Statistics*. Surgeon General, Department of the Army, Washington, D.C. (order from GPO, Supt. of Documents, Washington 25). 212 pp. \$2. Historical account of the development of this statistical system; the book is designed to show how to set up a system of record keeping.

Macfarlane, L. R. S. *A Short Synopsis of Human Protozoology and Helminthology*. Livingston, London; Williams and Wilkins, Baltimore, Md., 1960. 251 pp. \$7.50. The classification used is a simplified and modified version of the American system. Much of the book, which is based on notes used at the Royal Army Medical College, is

condensed from Craig and Faust's *Clinical Pathology*.

Marti-Ibanez, Felix, Ed. *Antibiotics Annual, 1959-60*. Antibiotica, New York, 1960. 1054 pp. \$15. Proceedings of the 7th annual symposium on antibiotics.

McDowell, Fletcher, and Harold G. Wolff, Eds. *Handbook of Neurological Diagnostic Methods*. Williams and Wilkins, Baltimore, Md., 1960. 210 pp. \$4.50.

*Medical Radioisotope Scanning*. International Atomic Energy Agency, Vienna, Austria, 1959 (order from UNESCO Publications Center, New York 22). 274 pp. \$4.

Nachmanson, David. *Molecular Biology*. Elementary processes of nerve conduction and muscle contraction. Academic Press, New York, 1960. 193 pp. \$7.50.

### Economics and the Social Sciences

Abbott, Lawrence. *Economics and the Modern World*. Harcourt, Brace, New York, 1960. 895 pp. \$6.95.

Arnold, Magda B. *Emotion and Personality*. vol. 1, *Psychological Aspects*; vol. 2, *Neurological and Physiological Aspects*. Columbia Univ. Press, New York, 1960. 310 pp.; 447 pp. \$7.50 each.

David, Henry P., and J. C. Brengelmann, Eds. *Perspectives in Personality Research*. Springer, New York, 1960. 380 pp.

Grotjahn, Martin. *Psychoanalysis and the Family Neurosis*. Norton, New York, 1960. 316 pp. \$5.95. Grotjahn is associate clinical professor of psychiatry at the University of Southern California and training analyst for the Institute for Psychoanalytic Medicine of Southern California.

Moseley, Philip E. *The Kremlin and World Politics*. Studies in Soviet policy and action. Vintage Books, New York, 1960. 567 pp. \$1.65. A collection of essays on Soviet policy and action during the past two decades. Moseley was formerly director of the Russian Institute at Columbia University.

Schoffelmayer, Victor H. *Southwest Trails*. To new horizons. Naylor, San Antonio, Tex., 1960. 259 pp. \$4.95. Schoffelmayer, science editor emeritus of the Dallas *Morning News*, writes on the agricultural development of the Southwest.

Simpson, George. *People in Families*. Sociology, psychoanalysis, and the American family. Crowell, New York, 1960. 569 pp. \$5.75. First volume in the Crowell series of sociology books; books in the series will be intended for "students and . . . thoughtful members of the general public." Series editor is Alfred McClung Lee.

Wolin, Sheldon S. *Politics and Vision*. Continuity and innovation in Western political thought. Little, Brown, Boston, 1960. 539 pp.

Wortis, Joseph, Ed. *Recent Advances in Biological Psychiatry*. Including a Havelock Ellis centenary symposium on sexual behavior. Grune and Stratton, New York, 1960. 431 pp. \$13.50. Proceedings of the 14th annual convention and scientific program of the Society of Biological Psychiatry, 1959.

Wriggins, W. Howard. *Ceylon: Dilemmas of a New Nation*. Princeton Univ. Press, Princeton, N.J., 1960. 518 pp. \$10.

### Miscellaneous Publications

(Inquiries concerning these publications should be addressed not to Science, but to the publisher or agency sponsoring the publication.)

Association de Géodésie. *Travaux*, vol. 20. *Rapports Généraux et Rapports Nationaux*. Etablis à l'occasion de l'Onzième assemblée générale. Fascicule 1, *Triangulations*. Pierre Tardi, Ed. Secrétariat de l'Association, Paris, 1958. 71 pp. + 32 reports.

Australia, Commonwealth Scientific and Industrial Research Organization. *List of Publications*. To 31 December 1959. CSIRO, Melbourne, 1960. 45 pp.

Barnet, J. *Bibliography of Plant Protection*, 1953. Biologische Bundesanstalt für Land- und Forstwirtschaft in Berlin-Dahlem, Berlin, 1960. 527 pp.

British Museum (Natural History). *Bulletin*. Geology, vol. 4, No. 4, "The Ordovician trilobite faunas of South Shropshire, 1," William Thornton Dean, 72 pp. 30s; Zoology, vol. 6, No. 6, "Contributions toward a classification of modern isopodidous fishes," William A. Gosline, 40pp., 15s. British Museum (Natural History), London, 1960.

*Diagnostic Roentgenology of the Digestive Tract without Contrast Media*. Vol. 27, No. 2, of *Journal of the Mount Sinai Hospital*. Bernard S. Wolf, Mansho T. Khilani, Arthur Lautkin, 185 pp. 1960. (This issue of the *Journal* is not available in reprint form, but it will be published by Grune & Stratton, New York.)

Kungl. Svenska Vetenskapsakademiens. *Årsbok*, 1959. Almqvist and Wiksell, Stockholm, Sweden, 1960. 530 pp.

McGill University. Arctic Meteorology Research Group. *Publ. in Meteorology* No. 18, "Temperature and wind frequency tables for Eurasia (January-March)," *Publ. in Meteorology* No. 20, "Temperature and wind frequency tables for Eurasia (April-June)," 206 pp. Quartermaster Research and Engineering Command, Natick, Mass., 1960.

*Nuclear Science Series*. NAS-NS 3004, "The radiochemistry of thorium," E. K. Hyde, 70 pp., \$0.75; NAS-NC 3005, "The radiochemistry of fluorine, chlorine, bromine and iodine," Jacob Kleinberg and G. A. Cowan, 52 pp., \$0.50; NAS-NS 3007, "The radiochemistry of chromium," J. Pijck, 34 pp., \$0.50. National Academy of Sciences-National Research Council, Washington, D.C., 1960 (order from Office of Technical Services, Department of Commerce, Washington 25).

Royal Society of Edinburgh. *Yearbook*. 1959-1960. The Society, Edinburgh, Scotland, 1960. 199 pp. \$5.25.

Smithsonian Institution. *Smithsonian Contributions to Astrophysics*, vol. 3, No. 9, "Geodetic uses of artificial satellites," George Vees, 70 pp.; vol. 4, No. 1, "Catalog of hourly meteor rates," Charles P. Oliver, 14 pp. *Smithsonian Miscellaneous Collections*, vol. 139, No. 11, "A classification for the birds of the world," Alexander Wetmore, 37 pp.; vol. 140, No. 1, "Classification and multiplicity of growth layers in the branches of trees," Waldo S. Glock, R. A. Stuhalter, and Shirlene R. Agerter, 292 pp. Smithsonian Institution, Washington 25, D.C., 1960.

*Studies on Agar Gel Electrophoresis*. Techniques-applications. R. J. Wieme. Arscia, Brussels, Belgium, 1959. 531 pp.

## Reports

### Competitive Exclusion

**Abstract.** It is contended that there is little justification and no necessity for believing in the competitive exclusion principle as usually formulated. There is danger that a trite maxim like this may lead to the neglect of important evidence.

In his usual lucid style, Garrett Hardin (1) has made a plea for the "competitive exclusion principle," otherwise known as "Gause's hypothesis," "Grinnell's axiom," and "the Volterra-Lotka law," which seems likely to speed this principle toward the status of dogma. Thus, Hardin joins such influential enthusiasts as Hutchinson and Deevey (2), who refer to this principle as "perhaps the most important theoretical development in general ecology" and as "one of the chief foundations of modern ecology."

Some ecologists, including myself, are afraid of dogma and see in this doctrine a device that may be used to avoid Hardin's admonition that "every instance of apparent coexistence must be accounted for." It is so easy to dismiss a field observation by merely saying that "they obviously have to occupy different niches or they couldn't coexist." As Hardin notes, the dictum is not susceptible to proof or disproof, so one who cares to use it in this manner is on firm ground. Let me, therefore, present part of the case for keeping an open mind on this matter. My special objections are to the undefined term "competition," to the weaknesses and oversimplifications of the theory that is supposed to support the exclusion principle, and to the summary dismissal of equally good (or bad) theories that lead to the opposite conclusion.

The various meanings that ecologists

*Instructions for preparing reports.* Begin the report with an abstract of from 45 to 55 words. The abstract should not repeat phrases employed in the title. It should work with the title to give the reader a summary of the results presented in the report proper.

Type manuscripts double-spaced and submit one ribbon copy and one carbon copy.

Limit the report proper to the equivalent of 1200 words. This space includes that occupied by illustrative material as well as by the references and notes.

Limit illustrative material to one 2-column figure (that is, a figure whose width equals two columns of text) or to one 2-column table or to two 1-column illustrations, which may consist of two figures or tables or one of each.

For further details see "Suggestions to Contributors" [Science 125, 16 (1957)].

have attached to the word "competition" have been discussed by Birch (3), and I shall not enumerate them here. Usage has been so inconsistent that one could probably make a case for defining competition as "that which eliminates one of two sympatric species occupying the same niche." In this form the exclusion principle makes a neat circular package; it is a law that admits of no exceptions provided that we are sufficiently flexible about the meanings we are willing to attach to the word "niche." I use this example merely to emphasize the semantic problems surrounding competitive exclusion. Hardin is frank about deliberately choosing ambiguous words to state the principle in the form "complete competitors cannot coexist," and I object on the grounds that ecologists are already wasting too much time debating about semantics rather than ecological principles.

As for the so-called theoretical demonstrations of the principle, Hardin's intuitive demonstration is much the simplest. It is undeniable that if a bank pays two depositors different rates of interest and confiscates the excess whenever the sum of the two accounts exceeds a fixed figure, the depositor receiving the lower interest rate is headed for insolvency. However, if we add just a touch of reality to the model by assuming that both men are horse players, it is no longer certain who will go bankrupt first; the situation is now nearer to Park's *Tribolium* experiments. Probability theory tells us that in such a model both men will eventually be ruined and that the probability and imminence of bankruptcy rises very sharply when one's capital happens to be reduced to a low level. If this model has reality for biological situations we may safely assert a principle more general than competitive exclusion, namely, "no two species can remain sympatric indefinitely whether or not they compete."

Volterra and Lotka derived their versions of the principle from extensions of the logistic theory, which has itself become the object of much criticism (4). In logistic theory, each added individual reduces the growth capacity of the population by a constant increment, with the result that the number of individuals,  $N$ , approaches asymptotically the carrying capacity,  $K$ , of the

particular habitat. Now, if we mix two species which have asymptotic population levels  $K_1$  and  $K_2$  respectively, and if an individual of either species reduces the growth capacity of both populations, the growth of the mixture can be expressed by differential equations. Let  $a_1$  represent the repressing effect of an individual of species 2 on the growth of species 1 expressed relative to the repression produced by an individual of species 1, and let  $a_2$  represent the corresponding inhibition of species 2 per individual of species 1. Then the outcome of the competition depends on the pair of inequalities  $a_1 < K_1/K_2$  and  $a_2 < K_2/K_1$ .

If the inequality signs are reversed one at a time it will be seen that there are four possible situations to be considered, of which the one shown represents the case where each species inhibits its own population growth more than it inhibits that of the other species. This is also the only case of the four in which the two species do form a stable mixture that will persist indefinitely. Hutchinson and Deevey dismiss this case because they feel that it "implies that the ecological niches of the two species do not overlap completely." Kostitzin (5) also dismisses the case, first because coexistence is possible "only in a quarter of the cases which may occur" and second, with a cryptic assertion that for two allied species the internal competition should be less violent than "the struggle between the two groups."

I do not understand the bases for the pronouncements of either Kostitzin or Hutchinson and Deevey. The point at issue is a conclusion of Darwin's coming from Chapter III of the *Origin*, just a few lines ahead of those quoted by Hardin: "But the struggle will almost invariably be most severe between the individuals of the same species, for they frequent the same districts, require the same food, and are exposed to the same dangers." If Darwin was right the Volterra-Lotka analyses predict not competitive exclusion but coexistence!

Finally, in an important paper (6), Skellam has provided a different type of theoretical example in which competitors can coexist. Boiled down to the simplest possible terms the argument is as follows:

Imagine an area  $A$  which includes just  $K$  "spots," which are small areas suitable for plant growth, and assume that, however many seeds may fall on a "spot," exactly one seedling grows to maturity there and produces  $B$  seeds. Of these, a number  $b$  (equal to  $BK/A$ ) will be distributed among the  $K$  spots. If at time  $t$  there are  $N_t$  annual plants on the area, they will yield a mean of  $bN_t/K$  seeds per spot. If the seeds are distributed at random over the area, the

distribution will be of the Poisson form. In this case,  $K e^{-bN_t/K}$  spots will be left vacant and  $K(1 - e^{-bN_t/K})$  spots will be seeded, so the population in the following year will be

$$N_{t+1} = K(1 - e^{-bN_t/K})$$

Skellam shows that this type of difference equation yields a discrete analog of logistic growth.

Now let us assume that we have two species with numbers  $N_1$  and  $N_2$  "struggling" for the  $K$  spots and, to be certain that we do not introduce anything that can be called a niche difference, we will assume that individuals of the two species produce the same number of seeds. Both species would be expected to miss seeding  $K e^{-b(N_1+N_2)/K}$  of the spots, species 1 should occur alone on

$$K e^{-bN_2/K}(1 - e^{-bN_1/K})$$

spots, species 2 should occur alone on

$$K e^{-bN_1/K}(1 - e^{-bN_2/K})$$

spots, and both species should fall on

$$K(1 - e^{-bN_1/K})(1 - e^{-bN_2/K})$$

spots.

If we assume that the species are equally good competitors, so that each "wins" on one-half of the spots seeded by both, it is easy to see that both species can be expected to persist. For example, the proportion of species 1 in the  $(t+1)$ st year is given by the formula

$$\frac{1}{2} + \frac{e^{-bN_2/K} - e^{-bN_1/K}}{2(1 - e^{-b(N_1+N_2)/K})}$$

so that, if at some point,  $N_1 = N_2$ , the species will continue indefinitely to be equally abundant.

If one objects to the assumption of random distribution of the seeds, he should note that the nonrandom spatial distributions which are typical in natural situations are usually of the type in which the number of occupied spots is smaller than predicted from the Poisson theory, thus increasing the opportunity for even an inefficient competitor to persist by seeding vacant spots. Skellam considers ecologically more interesting cases in which one of the competing species always loses on the spots seeded by both, and he shows that even in these cases the species can coexist, provided that the poorer competitor produces more seeds than the other species. He also shows that in a "good" habitat (where  $K/A$  is large) the inefficient competitor will be driven out, but that in a poor habitat greater fertility may outweigh competitive ability. I submit that it would be very unfortunate if ecologists should be persuaded by a doctrine that such matters are not worthy of consideration.

It has been suggested (7) that Skellam's model "is primarily applicable to annual plants with a definite breeding season, . . ." but it could doubtless be applied almost without change to, for example, woodducks or other hole-nesting birds, where the availability of "spots" suitable for reproduction limits population size. I am confident that such an approach can be applied to perennial species with modifications that leave it still at least as biologically realistic as the logistic model of competition.

Why, then, do empirical data seem to support the competitive exclusion principle? First, because, by definition, no two species are identical, so that if one looks closely enough he is bound to find something that can be considered a difference in the ecological niches. Second, because survival and reproduction are processes that always contain chance elements and have finite probabilities of failure. Hardin seems to believe that if Park could control environmental conditions accurately enough the competition between the two species of *Tribolium* would give "an invariable result." It is more probable, in fact I regard it as certain, that Park is correct in believing that he has discovered environmental conditions under which the two species are so nearly evenly matched that the stochastic elements take over and mediate the outcome. No amount of tinkering with temperature and relative humidity is going to cause the little ball always to hop into the same slot of a roulette wheel. Third, if a population is being held below the carrying capacity of its habitat by the necessity of sharing some limited environmental resource with another species, it should be self-evident that there will be a selective advantage for any new gene that reduces or eliminates this sharing. I consider that Darwin's finches have differentiated not because "Ecological differentiation is the necessary condition for coexistence" but simply because natural selection will promote the spread of genes that permit a population to enlarge by exploiting an unfilled ecological niche.

If we really must have a competitive exclusion principle for pedagogic purposes, I am willing to subscribe to something like: "Species cannot coexist indefinitely because of the inevitability of random extinction, but, for species that conform to certain rather restrictive rules, competition may speed the process of species elimination." Each ecologist can decide for himself whether or not such a principle should become one of the foundations for a branch of science.

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## References

1. G. Hardin, *Science* 131, 1292 (1960).
2. G. E. Hutchinson and E. S. Deevey, *Survey of Biological Progress* (Academic Press, New York, 1949) vol. 1, p. 325.
3. L. C. Birch, *Am. Naturalist* 91, 5 (1957).
4. F. E. Smith, *Ecology* 33, 441 (1952); H. G. Andrewartha and L. C. Birch, *The Distribution and Abundance of Animals* (Univ. of Chicago Press, Chicago, Ill., 1954).
5. V. A. Kostitzin, *Mathematical Biology* (G. Harrap Ltd., London, 1959).
6. J. G. Skellam, *Biometrika* 38, 196 (1951).
7. G. E. Hutchinson, *Cold Spring Harbor Symposia Quant. Biol.* 22, 415 (1957).

25 May 1960

## Pupil Size as Related to Interest Value of Visual Stimuli

*Abstract.* Increases in the size of the pupil of the eye have been found to accompany the viewing of emotionally toned or interesting visual stimuli. A technique for recording such changes has been developed, and preliminary results with cats and human beings are reported with attention being given to differences between the sexes in response to particular types of material.

Qualities which have nothing to do with vision as such have long been attributed to the eyes. Perhaps the most poetical expression of this is found in the lines of Guillaume de Salluste: "These lovely lamps, these windows of the soul." Even if the eyes are not the "windows of the soul," there is an increasing amount of evidence that the eyes, more specifically the pupils, register directly certain activities of the nervous system, including, but not restricted to, the effects of visual stimulation.

Kuntz (1) discusses the control of the constriction and dilation of the pupil by the sympathetic and parasympathetic divisions of the autonomic nervous system. The light reflex, which is a change in pupil size due to changes in environmental light conditions, is controlled by the parasympathetic division through the action of the ciliary ganglion. The role of the sympathetic division in determining the size of the pupil is more complex, but Kuntz points out that "strong emotional states are accompanied by general sympathetic stimulation" and that "deep emotions of pleasure as well as fear are commonly accompanied by pupillary dilation."

Evidence that control of pupillary dilation by the sympathetic division of the autonomic nervous system is governed by hypothalamic centers is discussed by Gellhorn (2), who concludes that "pupillary dilation is one of the most constant symptoms observed on stimulation of the hypothalamus." Furthermore, Gibbs and Gibbs (3) report that hypothalamic stimulation will elicit purring in cats, which is generally con-

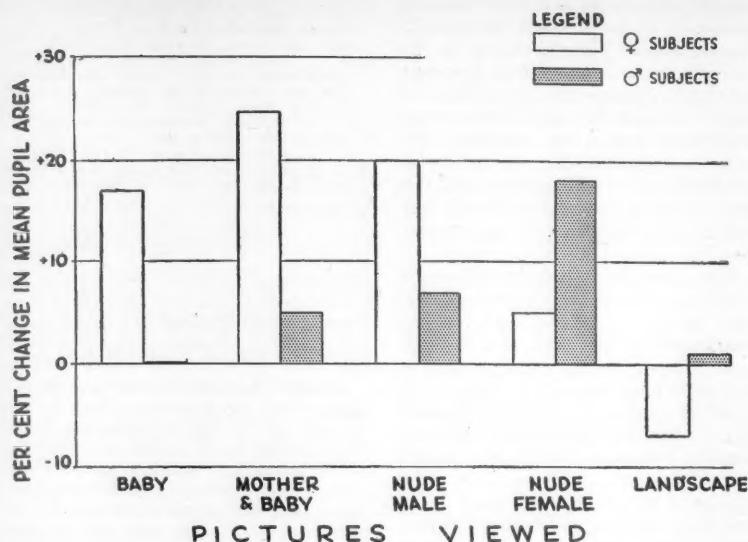


Fig. 1. Changes in mean pupil size, in terms of percentage of decrease or increase in area, from size during viewing of control patterns, in response to various pictures.

sidered to be an emotional expression of pleasure.

These findings are, of course, consistent with the vast amount of research done by Cannon and his collaborators, and also with their hypothesis that emotion is based on discharge over the sympatheticoadrenal system.

Some preliminary studies have been conducted at the University of Chicago with cats reared as pets and with intact laboratory animals, which indicated that under constant light conditions there were marked pupillary dilations in response to such stimuli as a relatively strange cat introduced into the home territory, a familiar object of play, and food. When food was not recognized, either because it was wrapped in paper or because it was an item foreign to the animal's normal diet, maximal dilation of the pupil did not occur until the scent of the food reached the animal.

To test the hypothesis that pupillary changes mediated by the sympathetic division, such as the changes we found in animals, could be used in human beings as both a quantitative and a qualitative measure of greater or less interest value and pleasure value of visual stimuli, we developed a technique for recording pupil size while the subject was shown visual material of different kinds.

Briefly, this technique involved obtaining exposures of the subject's eye on 16-mm film while he viewed a series consisting of test pictures alternated with a control pattern. Brightness was kept relatively constant in order to

rule out any effect of changes in level of illumination on the size of the pupil. It was found that the most expedient way to analyze the film record was to project the 16-mm frames with a Percepto-Scope (4) and measure the pupil size in the projected image. In the pilot study reported here, the six subjects consisted of one single female, one married female, three single males, and one married male. Neither of the married subjects had children.

The figures shown in Fig. 1 represent the mean area of the pupil in 20 exposures taken over a 10-second period during which a test picture was viewed in relation to the area in 20 exposures taken during the preceding 10-second presentation of the test pattern. This relationship is given for the six subjects for a picture of a baby, of a mother holding a young child, of a partially nude man, of a partially nude woman, and of a landscape.

These data show that there is a clear sexual dichotomy in regard to the interest value of the pictures, with no overlap between sexes for the first four pictures.

We purposely report the data for the small sample used in our first study to indicate the type of results obtainable with this technique with a minimum number of subjects. Further studies, in which we utilized similar materials and more subjects, gave essentially the same results. Test-retest series, given after an interval of 1 day, show an extremely reliable result for the subjects tested. The probability of getting results

of this degree of similarity by chance for any one subject falls below the .01 level.

The responses made to the picture of the baby and the picture of the mother and child substantiate an experiment conducted by Cann (5), who asked subjects to choose which picture they liked best in each of a series of pairs. Each pair consisted of an infant animal and an adult of the same species. Cann found that significantly more of the "baby" pictures were preferred by single women and by childless women than by single men and childless married men.

The responses to the pictures of the partially nude man and woman are what logically would be expected. Men are more interested in partially nude women, while women are more interested in partially nude men.

A comparison of the responses to the first four pictures with responses to the last emphasizes the possibilities for rating a wide range of material on the basis of interest value. It is also clear that differences in interest value of the various stimuli may be discerned within as well as between sexes.

Work now in progress deals with the range of visual materials for which reliable differences of pupil size can be found, as well as an exploration of how fine a discrimination will be possible with this technique. Further work deals with investigations of possible auditory effects on pupil size—for example, whether pleasant music causes pupillary dilation as compared to unpleasant sounds. Other avenues include the investigation of possible differences in pupil size when material dealing with experimental esthetics is presented.

The implications of this line of research seems to be far-reaching and could lead to a clearer understanding of behavior and its development at the human and infrahuman levels, through the study of a response with a basic mechanism which transcends gross species differences (6).

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#### References and Notes

1. A. Kuntz, *The Autonomic Nervous System* (Lea and Febiger, Philadelphia, 1929).
2. E. Gellhorn, *Autonomic Regulations* (Interscience, New York, 1943).
3. E. L. Gibbs and F. A. Gibbs, *J. Comp. Neurol.* 64, 209 (1936).
4. The Percepto-Scope is manufactured by Perceptual Development Laboratories, St. Louis, Mo.
5. M. A. Cann, thesis, University of Chicago (1953).
6. Part of this work was carried out at the Perception Research Laboratory of McCann-Erickson, Inc.

11 July 1960

## Improved Chlorophyll Extraction Method

**Abstract.** Filtered plankton samples subjected to sonic oscillations yielded 11 to 30 percent more chlorophyll *a* with acetone extraction than similar, nonsonicated samples. The improved chlorophyll extraction was attributed to algal cell-wall rupture.

Extracted plant pigments, particularly chlorophyll *a*, are used frequently in limnology and oceanography as a rapid method for estimating standing crops of phytoplankton, or, with light intensity, for estimating primary production. The various applications of extraction methods and some criticisms of the techniques, with an extensive list of references, were given in a recent review (1). Riley (2) and Ryther and Yentsch (3) reported instances in which anomalous results were obtained because of inability, with existing methods, to extract chlorophyll from all algal cells present in natural populations. Cells of small green algae are particularly resistant to extraction with the solvents commonly used. The investigation reported here was an attempt to find whether sonic oscillation would prove useful in extracting pigments from algal cells (4). Sonic oscillations are used widely in breaking bacterial cell walls to obtain cell fractions for study. If a sonic oscillator could also rupture algal cell walls, the chlorophyll present should readily go into solution.

A natural population of algae obtained from a tidal creek on Sapelo Island, Ga., was routinely cultured in enriched, settled sea water (Erdreich's medium). The algae were not identified specifically but were mainly pennate diatoms, together with some centric diatoms and many small cells less than 5  $\mu$  in diameter. The algae were grown in Fernbach flasks on a shaker, at temperatures from 16 to 22°C, under a bank of fluorescent lights which provided a light intensity of 2000 ft-c. The extraction method (5) was modified by the addition of 0.5-percent dimethylaniline (6) to the 90-percent acetone, instead of  $MgCO_3$ . The filters bearing algae to be sonicated were placed in the chamber of a 9-kv Raytheon sonic oscillator, and 10 ml of acetone solution was added to obtain sufficient liquid volume for effective sonification. The nonsonicated samples in acetone were placed overnight in a room at 4°C for an extraction time of at least 20 hours. The sonicated samples were either similarly stored or analyzed within several hours. Samples were centrifuged for 10 minutes before optical densities were read

on a Beckman model DU spectrophotometer. The chlorophyll *a* content was calculated by the method of Richards and Thompson (7). Samples were inspected periodically with a microscope to insure that a true solution was being read in the spectrophotometer.

The variability (including variability through personal and instrumental error) to be expected in the chlorophyll extraction method under these conditions was not known; therefore, 19 aliquots from a culture were extracted. The mean value for chlorophyll *a* was 2.0377 mg/m<sup>3</sup> with a standard error of 0.0603 mg/m<sup>3</sup>. Standard errors for sonicated samples were slightly larger than for similar, nonsonicated samples. It is probable that the manipulations required for sonification increased the variability of these samples. Efforts to reduce manipulations by sonifying the samples while they were in glass vials were not successful. Several different procedures were tested in order to develop the simplest technique. Preliminary experiments included sonification times of 1 hour, but these periods were reduced when it became evident that a maximum of 9 minutes was sufficient with these cultures. It was necessary to allow the sonicated samples to stand for a period of 2 to 4 hours to obtain an absolutely clear solution by centrifuging. Extension of the periods of extraction of the sonicated samples did not yield more chlorophyll.

Eleven to 30 percent more chlorophyll was obtained from sonicated samples than from similar, nonsonicated samples in six different experiments. Cultures of different ages were used but no trends were noted with regard to the effect of sonification and varying age of the culture. Rather, it appeared that the species composition was of greater importance. Periodic observations revealed a change in the dominant species of alga present in the cultures. The variation in the results of sonification may be attributed to changes in species composition. The chlorophyll was extracted from some algal cells without sonification, while it was necessary to rupture the cell walls of other cells. The broken cell walls were observed by microscopic examination of the residue from centrifugation. The duration of sonification necessary to obtain maximal yield of chlorophyll varied from 3 to 6 minutes, although 9-minute sonification periods were used routinely. Similar variable results with regard to the length of the sonification period may be expected when chlorophyll is extracted from natural populations. While sonification increases the variability in comparable

samples, it gives a better estimate of the concentration of chlorophyll *a*.

An attempt was made to sonicate some samples obtained from a muddy tidal creek. Sonification dispersed the silt in very fine particles which could not be removed either by centrifugation or by filtration through a fritted glass filter. The method will be of value in extracting chlorophyll from samples which are relatively free of silt. Use of this technique should eliminate anomalous results caused by the failure of the solvent to extract chlorophyll from intact algal cells. Although the cell residue is white, one would expect some chlorophyll to be present in that fraction because there is only a single extraction with the solvent.

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### References and Notes

1. J. W. G. Lund and J. F. Talling, *Botan. Rev.* 23, 489 (1957).
2. G. A. Riley, *Ecol. Monographs* 10, 279 (1940).
3. J. H. Ryther and C. S. Yentsch, *Limnol. and Oceanog.* 2, 281 (1957).
4. This report is contribution No. 23 from the University of Georgia Marine Institute, Sapelo Island, Ga. The research was supported by funds from the Sapelo Island Research Foundation. I wish to thank L. R. Pomeroy and E. J. Kuenzler for advice with this study, and R. M. Eisenberg for his proficient laboratory assistance. I appreciate the loan of the sonic oscillator from the department of bacteriology on the main campus of the university, Athens, Ga.
5. G. I. Creitz and F. A. Richards, *J. Marine Research (Sears Foundation)* 14, 211 (1955).
6. J. R. Vallentyne, *Can. J. Botany* 33, 304 (1955).
7. F. A. Richards with T. G. Thompson, *J. Marine Research (Sears Foundation)* 11, 156 (1952).

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18 May 1960

## Effect of Reserpine on Release of Noradrenaline from Transmitter Granules in Adrenergic Nerves

**Abstract.** Direct evidence is given that reserpine, in concentrations of 0.125 to 0.625 mM, effects a release of noradrenaline from a suspension of transmitter granules isolated from bovine splenic nerves.

Submicroscopic particles containing noradrenaline can be separated by centrifugation of homogenates or press juice from adrenergic nerves (1). In neutral isosmotic solution and at low temperature (5°C), the stability of the particles is high, as shown by the small loss of noradrenaline over a period of several hours. At higher temperature, at pH below 5, and in the presence of detergents, noradrenaline is more or less rapidly released from the particles (2).

Table 1. Noradrenaline released by incubation of granules from bovine splenic nerves with reserpine (lyophilized reserpine phosphate) or Serpasil solution. Suspension medium, 0.075M K-phosphate, pH 6.5 to 7.0. Incubation time, 30 minutes at 20°C.

Concentration (mM)	Noradrenaline left in granules (% of control)
Control solution	100
Reserpine solution	
0.025	95, 100
.075	76, 96
.125	66, 59
.175	52
.25	46, 33, 44, 37
.5	17
.625	26

It has been shown that reserpine causes a depletion of the catecholamines from the heart (3), from the hypothalamus (4), and from the suprarenal medulla (5). In the cat and the rat, denervation does not prevent the action on the adrenal medulla (6). With large doses of reserpine (5 mg/kg), noradrenaline was found to be released from the rabbit's heart even after section of the cord at C<sub>7</sub> and C<sub>8</sub> (7). Moreover, reserpine is active on the heart-lung preparation (8), and depletion of rat heart and intestine is not prevented by ganglionic blocking agents (9). These results suggest a direct action on the stores. The present report deals with the effect of reserpine on the release of noradrenaline from isolated granules from bovine splenic nerves.

Bovine splenic nerves were stripped of their sheath and a press juice was obtained by squeezing the nerves between nylon cylinders in the cold. The residue was washed with ice-cold 0.075M potassium phosphate of pH 7.5, 5 to

10 ml per gram of nerve. The combined press juice and washing fluid (pH 6.5 to 7.0) was centrifuged in the cold for 5 minutes at 1000g, and the sediment was discarded. The supernatant was centrifuged at 50,000g for 30 minutes at 3°C, and the sediment was resuspended in 0.075M potassium phosphate, pH 6.5 to 7.0. Reserpine was added to the phosphate buffer in various concentrations, and the suspension was gently agitated during incubation for 30 minutes at room temperature (20°C).

The reserpine preparations used were Serpasil (Ciba) and soluble lyophilized reserpine phosphate in the extract (10).

The controls were incubated with the solvents in the same way. Solutions made of the lyophilized reserpine phosphate in 0.075M potassium phosphate were stable at pH 6.5 to 7.0 at room temperature but showed precipitation at lower temperatures.

After incubation, the suspensions were re-centrifuged and the amounts of noradrenaline in the supernatant and in the sediment were estimated by a fluorimetric technique (11). The noradrenaline in the sediment was quantitatively released by the addition of 1 ml of 1-percent metaphosphoric acid, and the amount in the supernatant was estimated after sedimentation of the precipitated granules.

The effects of various concentrations of reserpine on the release of noradrenaline from the granules are shown in Table 1. From the table it can be seen that approximately one-half of the noradrenaline present in the control samples remains after incubation with 0.175 mM reserpine and that less than 30 percent remains after incubation with 0.5 to 0.625 mM reserpine for 30 minutes at room temperature.

Figure 1 shows the release of noradrenaline as a percentage of the total amount present in the primary sediment. As seen in Fig. 1, about 90 percent of the total noradrenaline is released in the presence of 0.5 mM reserpine during the experimental conditions, as against 29- to 39-percent release in the controls during the same period. No releasing action was found on incubation of the granules with Serpasil solvent.

The experimental results reported here (12) are in agreement with the assumption that reserpine depletes the transmitter in adrenergic nerves by acting directly on its stores. The results also give evidence that the effect may appear even when reserpine is allowed to act on isolated transmitter granules during a brief period, provided the concentration is sufficiently high. Lower concentrations acting over longer time

periods have not been tested, in view of the considerable spontaneous release at room temperature. At lower temperatures, on the other hand, reserpine was found to have little or no action, partly as a result of diminished solubility.

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#### References and Notes

- U. S. von Euler and N. A. Hillarp, *Nature* **177**, 44 (1956); U. S. von Euler, *Acta Physiol. Scand.* **43**, 155 (1958); H. J. Schümann, *Arch. exptl. Pathol. Pharmakol. Naunyn-Schmeidberg's* **234**, 17 (1958).
- U. S. von Euler, in preparation.
- A. Berlier, A. Carlsson, E. Rosengren, *Naturwissenschaften* **43**, 521 (1956).
- M. Holzbaud and M. Vogt, *J. Neurochem.* **1**, 8 (1956).
- A. Carlsson and N. A. Hillarp, *Kgl. Fysiograf. Sällskap. Lund Förh.* **26** (1956).
- G. Korneberg and H. J. Schümann, *Arch. exptl. Pathol. Pharmakol. Naunyn-Schmeidberg's* **231**, 349 (1957); B. A. Callingham and M. Mann, *Nature* **182**, 1020 (1958); B. L. Mirkin, *ibid.* **182**, 113 (1958).
- B. B. Brodie, J. S. Olin, R. G. Kuntzman, P. A. Shore, *Science* **125**, 1293 (1957).
- M. K. Paasonen and O. Krayer, *J. Pharmacol. Exptl. Therap.* **123**, 153 (1958).
- N. T. Kärki, M. K. Paasonen, P. A. Vanhakartio, *Acta Pharmacol. Toxicol.* **16**, 13 (1959).
- The Serpasil, reserpine phosphate, and solvent used in this study were kindly supplied by Ciba Products, Välingby, and Dr. Plummer (Ciba, Summit, N. J.), respectively.
- U. S. von Euler and F. Lishajko, *Acta Physiol. Scand.* **45**, 122 (1959).
- This work was supported by a grant from the Swedish Medical Research Council to U. S. von Euler which is gratefully acknowledged.

18 April 1960

#### Interhemispheric Effects of Cortical Lesions on Brain Biochemistry

**Abstract.** Unilateral lesions in the visual and somesthetic cortex of rat brain cause a slight but significant increase in the cortical cholinesterase activity in the contralateral hemisphere. There is some indication of strain differences in this effect. No change in cholinesterase activity is found in the subcortical brain. These findings may be helpful in understanding mechanisms of interdependence among brain areas.

A recurrent observation in the study of brain function is the apparent unity of the brain despite the equally apparent differentiation—Flourens' *action commune* and *action propre*. Limited cortical injury can show widespread effects in behavior presumably controlled by cortical tissue far removed from the site of injury; and a specific behavior pattern which deteriorates after ablation of its cortical center will show recovery with the passage of time or with special training. The mechanisms behind these phenomena have never been made clear.

One possible avenue for these generalized effects may be biochemical. Since

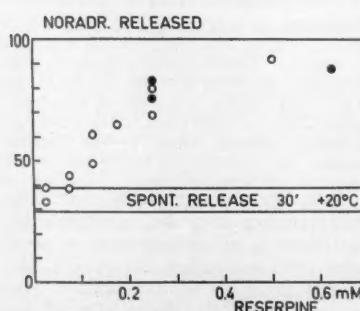


Fig. 1. Percentage of noradrenaline released by reserpine from granules isolated from bovine splenic nerves, sedimented, resuspended in 0.075M potassium phosphate, and incubated for 30 minutes at pH 6.5 to 7.0 at 20°C. Open circles, lyophilized reserpine phosphate; solid circles, Serpasil in ampule solution.

we had found reliable relations between cortical cholinesterase activity and adaptive behavior (1), and since cholinesterase activity is a general characteristic of the cortex (high interareal correlations being the rule), we investigated whether a limited cortical lesion might alter cholinesterase activity throughout the brain. We have been unable to discover any reports of generalized effects of limited cortical injury on brain biochemistry in either experimental animals or in man. This report concerns an exploratory study in this area—an area which we believe should be of concern not only for brain physiology but also for the medical management of brain injury.

In the main experiment 27 littermate pairs of 110-day-old rats of the S. strain were used. In one animal of each pair a variable amount of cortical tissue in the visual and somesthetic areas of one hemisphere was cauterized under ether anesthesia. In 12 animals the left hemisphere was operated on; in 15 animals, the right. Approximately 25 days after the operation the experimental animals and their littermate controls were decapitated and their brains prepared for chemical analysis. The cholinesterase activity of the visual, somesthetic, and motor cortical areas of the intact hemisphere were determined separately for each experimental animal. For each control animal these three areas were analyzed in the hemisphere corresponding to that of its experimental littermate. In addition, the cholinesterase activity of the subcortex (defined as total brain minus the dorsal cortex) was determined for every animal. The analytical procedure, with an automatic titrator, has been reported previously (1). Cholinesterase activity is measured in terms of moles of acetylcholine ( $\times 10^{10}$ ) hydrolyzed per minute per milligram of tissue.

To obtain some indication of the generality of the effect, 20 additional littermate pairs of rats of approximately the same age as the others but of three other strains were also tested. Of these, ten were from the S. strain and ten from the RDH and RDL strains. The S. strain was derived from the same parental stock as the S. strain. These two strains were developed by Tryon (2) through selective breeding for maze brightness (S.) and maze dullness (S.). The RDH and RDL strains came from a different parental stock and had been developed by Roderick (3) through selective breeding for high (RDH) and low (RDL) cortical cholinesterase activity.

The results are presented in Table 1. An analysis of variance of the S. data, taking into account the littermate de-

Table 1. Effects of cortical lesions on cholinesterase activity in contralateral cortex and in subcortex in various strains of rats. Missing *P* values indicate nonsignificant differences.

Item	S <sub>1</sub> ( <i>N</i> = 27 pairs)		S <sub>1</sub> ( <i>N</i> = 10 pairs)		RDH and RDL ( <i>N</i> = 10 pairs)	
	Cortex	Subcortex	Cortex	Subcortex	Cortex	Subcortex
Lesion	68.9	167.2	62.2	148.0	60.1	140.2
Control	67.2	165.4	59.3	148.2	59.8	139.2
Difference	1.7	1.8	2.9	-0.2	0.3	1.0
<i>P</i>	<.01		<.05			

sign, produced two main findings. (i) The over-all cholinesterase activity of the visual, somesthetic, and motor areas in the hemisphere contralateral to the lesion was significantly higher for lesion than for control animals ( $F = 9.25$ , degrees of freedom = 1 and 26,  $P < .01$ ). (ii) This effect did not differ significantly from one cortical area to another ( $F = .64$ , degrees of freedom = 2 and 52), and is thus generalized. Over-all, cortical cholinesterase activity in the lesion animals exceeded that in the control animals by 2.5 percent. This 2.5-percent increase can be of functional importance in view of the exceedingly small individual variability of cerebral cholinesterase activity (4). Actually, the increase represents about one-half of a standard deviation.

In the subcortex, in distinction from the cortex, the cholinesterase activity of lesion animals exceeded that of controls by 1.1 percent, and this difference was not significant.

Among the ten S. pairs, the results were similar to those of the S. animals; cortical cholinesterase was 4.9 percent greater in lesion than in control animals (significance at the .05 level of confidence). There was no difference in the subcortex. Among the ten pairs of RDH and RDL animals, cortical cholinesterase activity of the lesion animals exceeded that of the controls by only 0.5 percent, and the subcortical difference was only 0.7 percent; neither of these differences was significant. These observations, suggesting that strains may respond differently to cortical lesions, indicate the necessity of sampling several strains in further work.

The change in cholinesterase activity seems to be restricted to neural tissue similar to that in which the lesion is made. This is shown in our failure to find significant change in subcortical cholinesterase activity following cortical lesions and in the failure of Sperti and Sperti (5) to find changes in cerebellar cholinesterase activity following lesions in the cerebral cortex.

The observed increase in cholinesterase activity in the hemisphere contralateral to the lesion might be accounted for by either of the following hypotheses. (i) The increase is a

direct result of the lesion. Such increase in cholinesterase activity would have functional consequences in tissue far removed from the lesion. (ii) The lesion results in a re-routing of brain activity, and the increase of function in the intact tissue leads to a compensatory increase in the chemicals important in neural transmission.

Our second hypothesis is congruent with recent reports from other laboratories. Research in Belgium (6) has shown that unilateral cortical lesions in cats lead to exaggerated electrical activity in the homologous area of the contralateral hemisphere. This is most clearly seen in the secondary responses to afferent stimulation. English work (7) indicates increases in cholinesterase activity in rat brain after increases in neural activity, while, conversely, American and Italian research (8, 9) indicates decreases in cholinesterase activity following decreases in neural activity.

We have further experiments under way which may make it possible to decide between these hypotheses. Whatever the nature of the effect, further investigation of it may provide increased insight into the mechanisms of interdependence among brain areas (9).

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#### References and Notes

1. M. R. Rosenzweig, D. Krech, E. L. Bennett, in *Ciba Foundation, Symposium on the Neurological Basis of Behaviour* (Churchill, London, 1958).
2. R. C. Tryon, in *Yearbook, National Society for the Study of Education* (Public School Publ. Co., Bloomington, Ill., 1940).
3. T. H. Roderick, doctoral thesis, Univ. of California, Berkeley (1958).
4. E. L. Bennett, M. R. Rosenzweig, D. Krech, H. Karlsson, N. Dye, A. Ohlander, *J. Neurochem.* 3, 144 (1958).
5. L. Sperti and S. Sperti, *Experientia* 15, 441-442 (1959).
6. L. Franken and J. E. Desmedt, *Compt. rend. soc. biol.* 151, 2204 (1957).
7. W. J. Pepler and A. G. E. Pearse, *J. Neurochem.* 1, 193 (1957).
8. E. J. Boell, P. Greenfield, S. C. Shen, *J. Exptl. Zool.* 129, 415 (1955).
9. This investigation was supported in part by research grant M-1292 from the National Institutes of Health, Public Health Service, and in part by the U.S. Atomic Energy Commission.

29 April 1960

## Moisture Stress as a Requirement for Flowering of Coffee

**Abstract.** When coffee plants are watered at relatively short intervals, so as to maintain the water content of the soil at close to field capacity, the flower buds remain dormant and no fruits are formed. Irrigation or rain induces flowering only when preceded by a period of water shortage. Water stress is apparently essential to break the dormancy of coffee flower buds.

Coffee flower buds are formed only when the plants are subjected to short days (1, 2). After differentiation, the buds grow rather slowly for about 2 months to a size of 6 to 8 mm and then stop growing for many weeks or months (2, 3). Rain or irrigation is known to induce anthesis of many buds within 8 to 12 days, depending on temperature. Mes (4, 5) postulated that it is pre-

dominantly water stress which keeps the flower buds dormant, and that any treatment which decreases the water tension inside the buds would release the inhibition. Rain and submergence of the buds in water are efficient ways of breaking dormancy (4, 6), but according to Mes (4), soil irrigation is not as effective. However, Porteres (7) and Piringer and Borthwick (2) reported flowering of coffee after soil irrigation subsequent to a dry period.

In the desert coastal area of Peru, plant-water relationships may be readily studied because of the absence of rain. In a small coffee field at the Escuela Nacional de Agricultura, La Molina, near Lima, a group of 10-year-old plants belonging to the *Typica* variety, planted in 3- by 3-m plots, were subjected to two irrigation treatments (ten plants were treated in each case): (i) irrigation at weekly intervals; (ii) ir-

rigation when soil moisture reached close to the wilting point at a depth of 1 ft. Flower bud differentiation in this area apparently takes place from July to September, and flowering may occur several times from October to May, frequently being rather poor, apparently because of inadequate water management in some years. The soil is a deep sandy loam with a field capacity of 18 percent and a wilting point of 9.5 percent. The treatments were applied from September 1958 to March 1959 and repeated from October 1959 to January 1960. Soil samples for moisture determination were taken at weekly intervals, before irrigation, at three sites in each plot. Water was supplied by surface irrigation in sufficient quantity to wet the soil to a depth of at least 2 ft.

With weekly irrigation, soil moisture content remained always above 15 percent (60 percent available), and not a single flower bud opened throughout the experiments. The "dry" plot received surface irrigation on 12 December 1958 and on 10 January, 18 February, and 11 December 1959, when soil moisture was, respectively, 9.7, 10.0, 9.5, and 9.4 percent. Flowering occurred 10 to 11 days after each irrigation and was particularly abundant after the irrigations of December 1958 and December 1959, when the number of unopened buds was highest. Figure 1 illustrates the difference between results with the two treatments.

Contrary to the concept that water stress causes dormancy of coffee flower buds, these results indicate that water stress is apparently necessary to break bud dormancy. It is suggested that water stress removes a growth inhibitor responsible for bud dormancy. It apparently acts in a way comparable to chilling, whose influence on the dormancy of Temperate Zone plants is well known. One could perhaps speak of the "water stress requirement" as being just as important for coffee flowering as the "chilling requirement" is for many species in cold areas (8).

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### References and Notes

1. C. M. Franco, *Rev. Inst. café São Paulo* 15, 1586 (1940).
2. A. A. Piringer and H. A. Borthwick, *Turrialba* 5, 72 (1955).
3. M. G. Mes, *Portugaliae Acta Biologica* A4, 328 (1956).
4. —, *ibid.* A4, 342 (1956).
5. —, *ibid.* A5, 25 (1957).
6. P. T. Alvim, *Turrialba* 8, 64 (1958).
7. R. Porteres, *Agronomie Tropicale Nogent-sur-Marne* 1, 148 (1946).
8. I wish to acknowledge the technical assistance of Manuel Bravo and Luis Vargas.

24 March 1960

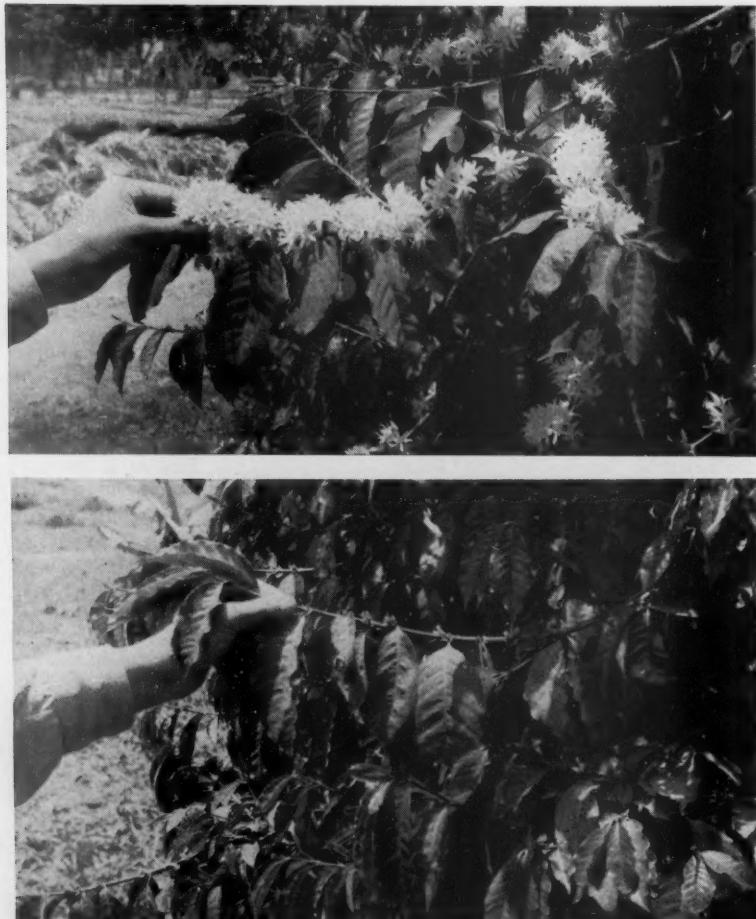


Fig. 1. (Top) Flowering, 10 days after irrigation subsequent to a dry period. (Bottom) Dormant buds in plants receiving weekly irrigation. The pictures were taken 21 December 1959.

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VOL. 132

## Two Forms of Chlorophyll a in vivo with Distinct Photochemical Functions

**Abstract.** Action spectra of the Emerson effect in *Chlorella* and *Navicula* reveal peaks at 670 m $\mu$ , in addition to those at 650 m $\mu$  (*Chlorella*) and 630 m $\mu$  (*Navicula*) attributable to chlorophylls *b* and *c*. Thus, excitation of chlorophyll *a* form "chlorophyll *a* 670" can supplement, in these algae, the excitation of the form "chlorophyll *a* 680-700." The effect of the auxiliary pigments in these algae may be mediated by energy transfer to "chlorophyll *a* 670."

Emerson and his co-workers (1, 2) found that the low quantum yield of photosynthesis at the red end of the absorption spectrum of algae ( $> 680$  m $\mu$  in green and brown algae,  $> 650$  m $\mu$  in red algae) can be significantly improved by auxiliary light of shorter wavelengths. The action spectrum of this "second Emerson effect" (3) was found to follow the absorption spectrum of the main auxiliary pigments (chlorophyll *b* in green algae, chlorophyll *c* and fucoxanthin in brown algae, the phycobilins in red and blue-green algae).

On the basis of a hypothesis first proposed by Duygens (4) to explain the action spectrum of chlorophyll fluorescence in red algae it has been suggested (2) that the reason the excitation of the auxiliary pigments improves the efficiency of photosynthesis in the long-wave region may be that this excitation is transferred, by resonance, preferentially to a particular photochemically active form of chlorophyll *a* which is not, or not strongly enough, excited by direct absorption of light  $> 680$  m $\mu$  in green and brown algae, and  $> 650$  m $\mu$  in red algae. If this is so, it should be possible to produce the same enhancement effect by direct absorption of light in this form of chlorophyll *a*, at least in green and brown algae, where it must be present in relative abundance to account for the high yield of photosynthesis in the 650- to 680-m $\mu$  range.

This is in fact the case. Figures 1A and 1B show the action spectra of the second Emerson effect (enhancement of the yield of photosynthesis in a band 685 to 700 m $\mu$  by monochromatic light). In addition to the previously observed peaks at 650 m $\mu$  (due to chlorophyll *b*) in *Chlorella*, and 630 m $\mu$  and 535 m $\mu$  (due to chlorophyll *c* and fucoxanthin, respectively) in *Navicula*, these curves have a sharp peak at 670 m $\mu$  missed in earlier measurements (see Figs. 7 and 8 in Emerson and Rabinowitch, 2) partly because of wider spacing of measured points. The presence in the absorption spectrum of these algae of a band at about 670

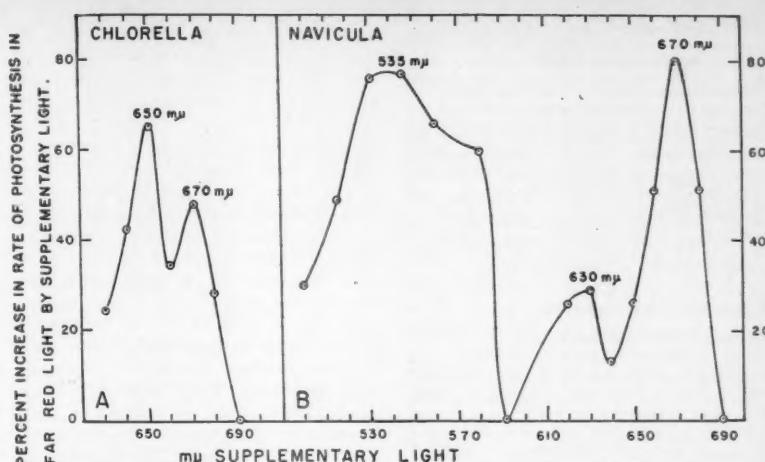


Fig. 1. Action spectra of the Emerson effect in (A) *Chlorella pyrenoidosa* Chick, strain 3, and (B) *Navicula minima* Grun. 535 m $\mu$ : at this wavelength, the largest proportion of light is absorbed by fucoxanthin; 630 m $\mu$ , by chlorophyll *c*; 650 m $\mu$ , by chlorophyll *b*; 670 m $\mu$ , by "chlorophyll *a* 670."

m $\mu$  (in addition to one at about 680 m $\mu$ ) is confirmed by closer consideration of the shape of this spectrum, particularly by the method of derivative spectra (French, 5). Only a single red band appears in this region in the spectrum of chlorophyll extracted from the algae; the 670 m $\mu$  and the 680 m $\mu$  bands, *in vivo*, must therefore belong to one and the same pigment, in different states of association or aggregation.

Krasnovsky and his co-workers (6) found evidence of preferential bleaching in leaf homogenates of a chlorophyll form with a band at 670 to 672 m $\mu$ ; they considered it to be the monomeric, fluorescent, and photochemically active component; but French (5), while confirming the existence of two bands (at 673 and 684 m $\mu$  respectively), found no essential difference in the rate of bleaching of "chlorophyll *a* 670" and "chlorophyll *a* 680." Brody (7) concluded, from fluorescence and spectroscopic studies, that the absorption band of chlorophyll *a* *in vivo* contains a component with a peak at about 690 m $\mu$ , which he attributed to a photochemically inactive and, at room temperature, nonfluorescent, dimeric chlorophyll molecule (since a similar band can be observed also in very concentrated chlorophyll *a* solutions). French (5) also saw indications of a third, minor band at 695 m $\mu$  in the derivative spectrum of *Chlorella*.

Exclusive association of "chlorophyll *a* 670" with both fluorescence and photochemical activity of chlorophyll *a* *in vivo* seems to be an oversimplification; but a specific photochemical function of the form of chlorophyll *a* in

*vivo* which has a band peak near 670 m $\mu$  is clearly confirmed by our experiments.

With the accumulating evidence of three spectroscopically different forms of chlorophyll *a* *in vivo*, the situation in algae becomes similar to that familiar from the case of purple bacteria, where three forms of bacteriochlorophyll (with absorption bands at 800, 850 and 890 m $\mu$ ) were long known to appear *in vivo*, and to give rise to only one band (at about 770 m $\mu$ ) upon extraction. The wider separation of these bands is in agreement with the generally greater influence of solvent on the position of the absorption bands of bacteriochlorophyll compared to those of chlorophyll *a* (8). It remains to be seen whether distinct photochemical functions must be attributed to all these forms, in bacteria as well as in algae (9).

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### References and Notes

1. R. Emerson, R. Chalmers, C. Cederstrand, M. Brody, *Science* 123, 673 (1956); R. Emerson, *Science* 125, 746 (1957); R. Emerson, R. Chalmers, C. Cederstrand, *Proc. Natl. Acad. Sci. U.S.A.* 43, 113 (1957); R. Emerson and R. Chalmers, *Phycol. Soc. Am. News Bull.* 11, 51 (1958); R. Emerson, *Ann. Rev. Plant Physiol.* 9, 1 (1958).
2. R. Emerson and E. Rabinowitch, *Plant Physiol.* (in press).
3. "Second" distinguishes this effect from the carbon dioxide burst at the beginning of a light period, often designated as the "Emerson effect."
4. L. N. M. Duygens, thesis, Univ. of Utrecht (1952).
5. J. S. Brown and C. S. French, *Plant Physiol.* 34, 305 (1959).

6. L. M. Vorobyova and A. A. Krasnovsky, *Biokhimiya* **21**, 126 (1956); **23**, 760 (1958).
7. S. S. Brody, *Science* **128**, 838 (1958).
8. E. Rabinowitch, *Photosynthesis and Related Processes* (Interscience, New York, 1951), vol. 2, pt. 1, Figs. 21-25, p. 641.
9. We are thankful to Prof. J. B. Thomas, Mrs. Rajni Govindjee, and Mr. Carl Cederstrand for their assistance in this investigation, which was carried out with the support of National Science Foundation grant G4969.

21 March 1960

## Capacity Electrode for Chronic Stimulation

**Abstract.** An electrode is described which can be used for electrical stimulation over prolonged periods without danger of contaminating tissue with electrode products. Use of a thoroughly insulated metal surface precludes all electrode processes, although a transient current can occur to stimulate the tissue.

It has not been demonstrated conclusively that ionic and gaseous products resulting from an electrode process can produce toxic depression of excitability and, perhaps, even block of conduction. Nevertheless, the suspicion that such effects might occur has encouraged the development of an electrode wherein the possibility of electrode reaction products is completely precluded. Such an electrode has been developed and tested and found to behave perfectly in the electrical stimulation of excitable tissues.

The mechanism underlying the behavior of this electrode depends merely on the electric field which arises as the primary event in any conventional electrode when the metal wire is initially charged upon being connected to the source of current. If the metallic wire should be deliberately insulated, the migration of ions by the action of the primary field will give rise to an accumulation of ions at the outer surface of the insulation which will abolish the field in the surrounding volume. The time interval required for this event to take place—the "charging" time—is usually very brief, depending primarily upon the area of electrode surface immersed in the solution and the thickness and dielectric constant of the insulation. We assume, of course, that the impedance of the charging source is negligible. The brevity of this charging event unfortunately makes such an electric field rather useless for the stimulation of excitable tissues, since, in view of the current strength-duration relationship of most tissues, the peak currents necessary would demand prohibitive charging potentials and would immediately cause dielectric breakdown of the insulating surface layer.

What is required is to extend the

duration of current flow and also to confine the current to a small area of excitable tissue. This can be done with a large area of insulated metallic surface enclosed by an insulated cavity—the cavity being filled with electrolyte, namely, Ringer's solution—which opens to the tissue via a polyethylene tube. This electrode displays the behavior of a series resistor-capacitor network, where the capacitance for a given thickness of insulation is proportional to the surface area of the wire and the resistance is proportional to the length and inversely proportional to the area of cross section of the tube leading from the cavity. Thus, when a square-wave voltage pulse is applied, a differentiated ("biphasic") response of current is obtained. The indifferent electrode need only be a conventional wire electrode in most cases.

A typical construction of the capacity electrode is shown in Fig. 1: The  $\frac{1}{4}$ - by  $\frac{1}{2}$ -inch cavity is milled from a polyethylene block ( $\frac{3}{4}$  by  $\frac{1}{8}$  inch), a thin wall of material being left to serve as the floor of the cavity. In the final assembly the cavity is closed with a thin plate of polyethylene which is sealed to the cavity walls by heating with a soldering iron. The current from the cavity is conveyed to the nerve via a 1-cm length of PE 50 polyethylene tubing (1). A length of PE 240 tubing is used as a cuff, slit to allow entry of the nerve. The metallic surface is provided most practically by a four-layer Teflon-coated No. 30 copper or stainless steel wire (2). The wire is coiled to fit the cavity and is threaded through the PE 90 tubing which is sealed with a small flame. Filling is accomplished quite easily by immersing the electrode in Ringer's solution and pumping down for 30 minutes with a filter pump. In the assembly shown in Fig. 1, a length of wire approximately 2 ft long and approximately 1 cm of PE 50 tubing results in an electrode with a time constant of approximately 80  $\mu$ sec. Such an electrode, when used to stimulate a frog sciatic nerve, requires about a 10-volt square pulse (0.2 msec duration) to obtain a current of sufficient magnitude and duration for excitation. The phrenic nerve of the dog required about a 20-volt pulse. Larger cavities have been used to accommodate lengths of wire of about 6 ft to provide a longer time constant for cardiac stimulation. In this case it has been found convenient to bring out the polyethylene tube from the wall of the cavity instead of the end as shown in Fig. 1. Thus, when the cavity is sutured to the ventricular surface the polyethylene tube (several millimeters long) of necessity presses into the myocardium. (In a more recent

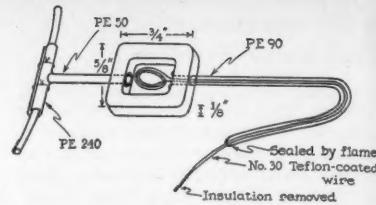


Fig. 1. Sketch of capacity electrode.

version the tube has been eliminated entirely, whereupon the hole in the wall of the cavity is flush with the ventricular surface.) Variants of this design are being explored for use in cortical stimulation. A "bipolar" electrode can be constructed with two cavities adjacent to one another with the pair of polyethylene tubes extending to the cuff in the case of nerve stimulation or into the myocardium in the case of cardiac stimulation.

The capacity electrode should be useful in any situation where it is found necessary, for whatever reason, to completely eliminate the possibility of electrode reaction products.

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### Notes

1. The polyethylene tubing was obtained from the Clay-Adams Co.
2. Wire was obtained from Hittemp Co., Mineola, N.Y. Note that ordinary single-layer Teflon-coated wire is inadequate because of the presence of occasional pin holes.

17 March 1960

## Age at Menopause of Urban Zulu Women

**Abstract.** Interviews with a population sample of Zulu women residing in Durban, Union of South Africa, indicated a tendency for the permanent cessation of menstruation to occur late. The median menopausal age of 33 women questioned within 5 years of their menopause was 48.6 years, and their mean menopausal age was 49.2 years. It is suggested that this may be an effect of malnutrition or of climatic factors.

There is considerable variation in the average menopausal age of various groups of women (1). This variation has been ascribed to genetic and other factors.

Recently the opportunity arose, in the course of two investigations carried out in Durban, Union of South Africa, to inquire into the menopausal age of urban Zulu women. The female subjects in two population samples were asked whether or not their menses had ceased, and the time lapse since their menopause.

Of the 109 postmenopausal women questioned, only 60 were certain of their age and the lapse since their menopause; five of these had had an artificially induced menopause. The present findings thus relate to 55 women. In view of the absence of published studies of the menopausal age of Zulu women, the findings are presented in spite of the small size of the sample.

The median menopausal age of these 55 women was 48.1 years, and their mean menopausal age 47.7 years (standard deviation, 5.80). More reliable figures are those based on the responses of the 33 women whose menopause had occurred within the previous 5 years; the median menopausal age of these women was 48.6 years, and the mean age was 49.2 years (S.D., 4.15).

These average values are high by comparison with those for most other groups of women. Of 22 groups cited by Pearl (1), only four had a later mean menopausal age, and six a later median menopausal age, than the 55 Zulu women questioned. Only one of these 22 groups had a later mean menopausal age, and only four a later median menopausal age, than the 33 Zulu women questioned within 5 years of their menopause. The findings thus suggest that the menopause tends to occur relatively late among urban Zulu women.

There is a high prevalence of malnutrition in this community (2). As there may be considerable involvement of the reproductive system in states of malnutrition (3), it is possible that malnutrition is a contributory factor to their late menopause. It is known that adolescence may be delayed in malnourished children (4), and it may be that the menopause is similarly delayed. Although it is commonly stated that a late menarche tends to be associated with an early menopause, there is apparently no statistical evidence for this assertion (5); a recent retrospective study of South African white women revealed no evidence of such an association (6). While ethnic, climatic, and other factors may play a role, it is noteworthy that it has been stated, in respect of maturation at an earlier phase of life, that "so far as can be ascertained from present data neither climate nor race influence the time of adolescence as greatly as nutrition, at least where the differences in nutritional status are wide" (4). It is possible that the late menopause of these Zulu women may reflect a slow tempo of development, partly related to malnutrition in early life or throughout life. This suggestion is in conformity with the impression (7) that in the United States the menopause now occurs earlier than formerly, and that business and professional women tend to have an early menopause.

Because, however, a recent study of white women in South Africa, who have considerably less malnutrition, has also revealed a late menopausal age (6), the importance of climatic factors cannot be excluded.

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#### References and Notes

1. R. Pearl, *The Natural History of Population* (Oxford Univ. Press, London, 1939).
2. J. H. Abramson, B. Gampel, C. Slome, N. Scotch, *Amer. J. Clin. Nutrition*, in press.
3. J. Gillman and T. Gillman, *Perspectives in Human Malnutrition* (Grune and Stratton, New York, 1951).
4. J. M. Tanner, *Growth at Adolescence* (Blackwell Scientific Publications, Oxford, 1955).
5. T. N. MacGregor, *Practitioner* 182, 539 (1959).
6. F. Benjamin, *S. African Med. J.* 34, 316 (1960).
7. E. C. Hamblen, in *Geriatric Medicine*, E. J. Stieglitz, Ed. (Saunders, Philadelphia and London, 1949).

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3 May 1960

## Two c-Type Cytochromes from Light- and Dark-Grown *Euglena*

**Abstract.** A pigment-protein complex can be extracted, in aqueous 2-percent digitonin, from *Euglena* grown in the light. When further fractionated by acetone and ammonium sulfate this flagellate yields a c-type cytochrome. By similar extraction of dark-grown, nonphotosynthetic *Euglena*, another c-type cytochrome can be isolated. The cytochrome from the light-grown *Euglena* is like that of cytochrome c isolated from a photosynthetic bacterium. The cytochrome from the dark-grown *Euglena* is like cytochrome f found in the chloroplasts of higher plants.

It has been postulated that a photosynthetic enzyme, a cytochrome, is intimately linked with the oxidation-reduction within the chloroplast and plays a part in the primary events of photosynthesis. Such cytochromes have been isolated from higher plants, algae, and photosynthetic bacteria and have been referred to as cytochrome f, cytochrome b<sub>6</sub>, and modified cytochrome c (1-3). A cytochrome with an  $\alpha$ -band absorption maximum at 552 m $\mu$  has recently been isolated by acid extraction from the light-grown photosynthetic algal flagellate *Euglena* but not from the dark-grown *Euglena* (4). Although mixed porphyrins from dark-grown *Euglena* had been previously shown,

no known cytochrome c absorption peaks were identifiable (5).

In previous studies the chlorophyll-protein complex, chloroplastin, obtained by digitonin extraction of chloroplasts from *Euglena*, exhibited photochemical activity, such as the photoreduction of a dye and the evolution of oxygen (6). The photo-oxidation of cytochrome c has also been demonstrated with digitonin-extracted spinach chloroplasts (7).

The question, then, is whether digitonin extracts a cytochrome (as well as a chlorophyll complex) which may be responsible for the photochemical activity, and if it does, whether a similar cytochrome is present in the nonphotosynthetic, dark-grown *Euglena*. We have now isolated from digitonin extracts of *Euglena* two c-type cytochromes: one from the photosynthetic, light-grown flagellate and another from the nonphotosynthetic, dark-grown flagellate.

Cells were collected for extraction from *Euglena gracilis* (Z) cultures grown in a chemically defined medium (pH 3.0) at 25°C under continuous illumination (300 ft-cs) and in darkness for 10 to 14 days. *Euglena* grown in the light carries on photosynthesis and synthesizes chlorophyll, and the cultures become a deep green. *Euglena* grown in the dark is nonphotosynthetic and does not synthesize chlorophyll, and the cultures are yellow to orange. The dark-grown *Euglena* cultures, which were initiated from a light-grown culture, were maintained in the dark for more than 8 months. These cultures are still capable of synthesizing chlorophyll when placed in the light. Ten grams of packed *Euglena*, after being washed twice in physiological saline, were ground with glass homogenizing beads at a salt-ice temperature (-10°C) in 8 to 10 ml of 2-percent digitonin in a Waring blender for 1 to 2 minutes. This technique gave good cell breakage and assured efficient extraction. The homogenate was further extracted at room temperature in the dark for 6 to 12 hours and was then centrifuged at 20,000g for 15 minutes. To separate the proteins from the pigments and lipids, the supernatant was precipitated in the cold in 80-percent acetone for several hours. This precipitate was washed in acetone, air-dried, taken up in distilled water, and brought to pH 9 to 10 with alkali. After standing 1 to 2 hours at room temperature, the insoluble proteins were centrifuged out, and the water-soluble fraction was neutralized with dilute sulfuric acid. It was then fractionated in the cold with ammonium sulfate at 45 percent of saturation, and the precipitate was removed by centrifugation. The brown supernatant was again fractionated with am-

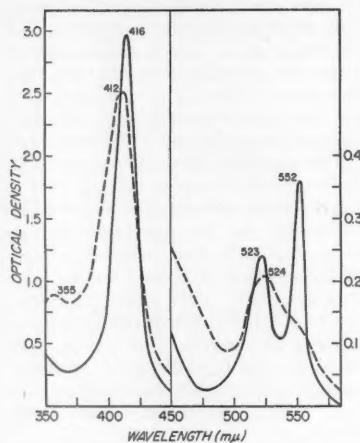


Fig. 1. Absorption spectra of the cytochrome isolated from the digitonin extract of photosynthetic, light-grown *Euglena*. Solid line, spectrum of the reduced cytochrome; broken line, spectrum of the oxidized cytochrome.

monium sulfate at 90 percent of saturation. The precipitate, now pink in color, was redissolved in 10 ml of distilled water and reprecipitated with 90-percent ammonium sulfate. This precipitate was then dissolved in 3 to 5 ml of water and dialyzed for at least 6 hours in the cold against two or three changes of 1-l. volumes of distilled water. The nondialyzable material was cleared by centrifugation, and the absorption spectrum of the supernatant was immedi-

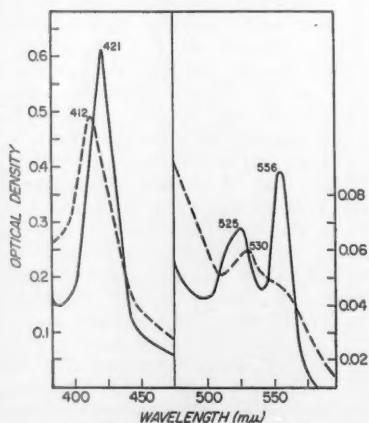


Fig. 2. Absorption spectra of the cytochrome isolated from the digitonin extract of nonphotosynthetic, dark-grown *Euglena*. Solid line, spectrum of the reduced cytochrome; broken line, spectrum of the oxidized cytochrome.

ately measured in the Beckman DK-1 spectrophotometer. Absorption maxima were checked in the Beckman DU spectrophotometer. The cytochrome concentration was calculated from the molar extinction coefficient of cytochrome *c* ( $2.8 \times 10^4 \text{ cm}^2/\text{mole}$ ) as described by Davenport and Hill (1), and chlorophyll concentration was determined from the absorption spectrum of the acetone-soluble pigment fraction (8).

The absorption spectrum showed that the oxidized form of cytochrome had been isolated. A reduced absorption spectrum was obtained by adding a few crystals of sodium dithionite. The cytochrome was then reoxidized by the addition of  $5 \times 10^{-3} M$  potassium ferricyanide. The initial absorption spectrum of the oxidized cytochrome and that obtained after ferricyanide treatment were identical. The absorption spectra of the reduced and oxidized cytochrome from the light-grown *Euglena* are shown in Fig. 1. Absorption peaks for the reduced cytochrome are at 552, 523, 416, and 315 mμ; for cytochrome in the oxidized state the absorption peaks are at 524, 412, and 355 mμ. These absorption maxima for the reduced and oxidized cytochrome closely resemble those for the cytochrome *c* of *Chromatium*, a photosynthetic bacterium (3). They differ from those for the recently reported *Euglena* cytochrome-552 (4) and from those for cytochrome *f* (1, 2) in that the typical cytochrome *c* shift of the  $\beta$ -band fails to occur. That our *Euglena* cytochrome has a *c*-type heme group was determined from the spectra of the alkaline pyridine and of the dicyanide hemochromogens.

The cytochrome fraction from light-grown *Euglena* was then further purified by centrifugation in the ultracentrifuge for 2 hours at 40,000 rev/min. The supernatant containing the cytochrome was dried by lyophilization. The resulting powder was dissolved in water, and paper electrophoresis was carried out in citrate-phosphate buffer at pH 6.1. The electrophoretic pattern revealed three anode-migrating components: a major slow-moving band containing the cytochrome and two rapidly migrating bands. Cytochrome *f* also moves toward the anode, while the *c*-type cytochromes from photosynthetic bacteria and the *Euglena* cytochrome-552 move toward the cathode. The rate of migration of the cytochrome under study was relatively slow, being only two-fifths that of bovine albumin.

According to our calculations light-

grown *Euglena* contains  $6.6 \times 10^{-7}$  mole of chlorophyll to every  $2.3 \times 10^{-8}$  mole of cytochrome. This corresponds to a molar ratio of 300:1, which is in agreement with the chlorophyll-to-cytochrome-*f* ratio obtained by others (1).

From dark-grown *Euglena* the cytochrome is similarly isolated in the oxidized state and has absorption peaks at 530 and 421 mμ; for the reduced cytochrome, the absorption peaks occur at 556, 525, and 412 mμ. These data are shown in Fig. 2. Although the typical cytochrome *c* shift is present, the spectrum is not that of typical cytochrome *c*. It is closer to the spectrum of cytochrome *f* (a modified cytochrome *c*), which is peculiar to photosynthetic cells. However, dark-grown *Euglena* are not photosynthetic but, as already indicated, resume photosynthesis when brought back into the light.

It was also determined that there is five times as much cytochrome in the light-grown as in the dark-grown *Euglena*. Since *Euglena* grown in the dark are nonphotosynthetic, this cytochrome may be part of the respiratory electron transport mechanism. If so, this cytochrome should also be present in the photosynthetic organisms, but its spectrum would be masked due to its low concentration. However, the similarity between the absorption spectra of this cytochrome and of the photosynthetic cytochrome *f* indicates that further studies are needed to elucidate the functional role that these enzymes play in the mechanism of photosynthesis (9).

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#### References and Notes

1. H. E. Davenport and R. Hill, *Proc. Roy. Soc. London* **B139**, 327 (1952).
2. R. Hill and F. Bendall, *Nature* **186**, 136 (1960).
3. M. D. Kamen, in *Enzymes: Units of Biological Structure and Function* (Academic Press, New York, 1956), p. 483; R. G. Bartsch and M. D. Kamen, *J. Biol. Chem.* **235**, 825 (1960).
4. M. Nishimura, *J. Biochem.* **46**, 219 (1959).
5. J. J. Wolken and A. D. Mellon, *J. Gen. Physiol.* **39**, 675 (1956).
6. R. A. Versole and J. J. Wolken, *Science* **127**, 1287 (1958).
7. R. H. Nieman and B. Vennesland, *ibid.* **125**, 353 (1957).
8. D. I. Arnon, *Plant Physiol.* **24**, 1 (1949).
9. The senior author is a Stoner-Mudge Foundation fellow. These researches are being aided in part by the U.S. Public Health Service's Institute of Neurological Diseases and Blindness (grant No. B-397-C6) and the National Science Foundation (grant No. G-9873).

19 May 1960

## Association Affairs

### AAAS Finances: Report for 1959

The 1959 income of the Association for normal and continuing operating expenses was, for the first time, over \$1 million. The exact amount was \$1,184,493.81. This sum came from the following sources:

Annual dues paid by members	\$ 438,742.42
Money transferred from Investment Account to pay for subscriptions for emeritus and life members	8,810.25
Subscriptions to <i>Science</i> by nonmembers	75,628.14
Sales of single copies and back issues	3,306.83
Advertising in <i>Science</i>	440,169.17
Sales of symposium volumes	51,431.75
Annual meeting: registration fees, exposition space, advertising in program, and contributions	44,378.92
Income from investment of funds not needed in checking account	23,108.16
Rental income from third floor and garage	20,631.93
Allowance for expenses incurred in administering grants	64,978.42
Miscellaneous receipts	13,307.82
Total	\$1,184,493.81

These receipts amounted to \$146,017.39 more than the operating expenses, chief items of which were:

Printing and editing <i>Science</i>	\$ 581,739.74
Cost of selling advertising in <i>Science</i>	110,042.29
Cost of symposium volumes sold during the year	29,801.55
Expenses of the annual meeting	40,947.91
Allowances (\$1 per member) to Pacific, Southwestern and Rocky Mountain, and Alaska Divisions	8,848.00
Expenses of AAAS sections	5,026.21
Board of Directors' meetings	5,109.46
Meetings of committees	4,943.36
Administrative and general expenses	45,987.16
Business office: salaries and other expenses	97,585.74

penses would have been \$106,428.69, in comparison with the 1958 figure of \$37,376.79.

### Grants Administered during 1959

Funds from grants received during 1959 or held over from earlier years amounted to \$1,080,721.52. Grant funds expended during the year amounted to \$881,687.33. Unexpended grant funds amounting to \$2910.96 were returned to the donors, leaving an unexpended balance to carry over into 1960 of \$196,123.23.

The largest grant administered was, as in 1958, for the Traveling Science Libraries administered by the AAAS and supported by the National Science Foundation. Traveling libraries of science books were distributed to 1700 high schools in the 1959-60 school year. A similar program of traveling libraries for elementary schools was started, with sets of the elementary libraries distributed to 800 schools. The total amount of money available for the traveling libraries during the year was \$658,962.51. Expenses amounted to \$641,842, leaving a balance of \$17,120.51.

The next largest grant account was for the expenses of the first International Oceanographic Congress. The Association started the year with a deficit of \$3179.15 in this account, received \$112,517.98, spent \$104,118.82, and ended the year with a balance of \$5220.01.

The third largest grant account was for the Science Teaching Improvement Program, to which the Carnegie Corporation has been giving support. The sum of \$82,874 remained in this account at the beginning of the year, and during the year the Association received from the Carnegie Corporation \$83,333, making a total of \$166,207. Expenses for 1959 came to \$62,645.87, leaving a balance of \$103,561.13.

During 1959 the Association also received from the Carnegie Corporation \$81,000 to support a study of certification of high school science and mathematics teachers. The study is being conducted by the National Association of State Directors of Teacher Education and Certification but is under the sponsorship of the AAAS. The program was started in the fall of 1959. Expenses in 1959 were only \$2056.44, leaving a balance of 78,943.56.

Other amounts were received during 1959, or balances were held over from 1958, for a variety of other activities, some of which were completed during the year, others of which have continued into 1960.

The \$788.80 remainder of a grant from the Carnegie Corporation to support two small conferences on testing and guidance of students was returned to the Carnegie Corporation.

The \$6916.02 balance of a grant of \$9000 from the Rockefeller Foundation to support a study by Margaret Mead and Rhoda Metraux of the attitudes of students was wholly expended.

In the account of a grant from the National Science Foundation, there remained \$2932.69 with which to pay the expenses of a lecture series for scientists in the Washington, D.C., area. During the year the Association spent \$810.53 from this account and returned the remainder to the National Science Foundation. The lecture series is being carried on by the National Science Foundation without AAAS assistance.

Under contract with the National Science Foundation, the AAAS selected several hundred high school science and mathematics teachers who were deemed qualified for graduate work in the fields in which they are teaching and who were recommended to the National Science Foundation for fellowships for one, two, or three summers of graduate work. At the beginning of 1959 there was a deficit in this account of \$11,453.45. The contract funds received from NSF during the year amounted to \$38,619.82. Expenses for the year were \$38,917.43, leaving at the end of the year a deficit of \$11,751.06. Work on this program is concentrated in the period from November through March. The deficit at the end of 1959, like the one of a year earlier, merely means that expenses had been incurred for which the Association had not yet been reimbursed. Reimbursement from NSF is on a cost basis.

From the Westinghouse Educational Foundation the Association received \$7500 to support two annual awards in newspaper and magazine science writing, the expenses associated with announcing these awards and selecting the winners, and the expenses incurred in giving a dinner for the National Science Writers Association at which the award winners are announced. The amount was wholly expended.

The Association received a grant of \$7500 from the Asia Foundation with which to send sets of science books to Southeast Asia. The expenses during the year amounted to \$5329.78, leaving a balance of \$2170.22.

From the Asia Foundation the Association also received \$3000 with which to provide subscriptions to *Science* for scientists living in Asia or to help Asian scientists resident in the United States attend the Association's annual meeting. Expenses during the year came to \$1371.66; the balance remaining at the end of the year was \$1628.34.

In March of 1959 the Association, in collaboration with the Alfred P. Sloan Foundation and the National

Academy of Sciences, conducted a Symposium on Basic Research. Most of the expenses were borne directly by the Sloan Foundation; the AAAS was reimbursed for those it incurred by a grant from the Sloan Foundation: \$9200.90 was received during 1959, \$769.48 after the end of the year.

#### Investment Account

Investment funds of the Association are handled separately from grants and from funds for current operations. Investment funds at the end of 1959 amounted, at current market prices, to \$819,327.76. At the end of the year this amount was invested as follows (all figures are in terms of market price as of 31 December 1959):

U.S. Government bonds and notes	\$210,931.26
Industrial bonds	179,387.50
Preferred stocks	35,103.75
Common stocks	393,905.25
Total	\$819,327.76

This amount includes \$197,916.61 of current funds not required for operating expenses and also includes \$40,180.95 as the endowment of the Gordon Research Conferences.

During the year the Association received \$27,518.48 from dividends and interest on investments. This income amounted to a return of about 3.7 percent on the book value of the securities. The yield in terms of market value amounted to about 3.4 percent. The Association also realized a net gain on the sale and exchange of securities of \$34,287.22, making a total income from the investment portfolio of \$61,805.70. This amount was distributed as follows:

For investment counsel and cost of servicing securities	\$ 2,774.19
To endowment, reserve, and prize funds	41,452.38
To current account	13,808.01
For Gordon Research Conferences, Inc.	3,771.12
Total	\$61,805.70

Of the amount for the Gordon Research Conferences, \$1399.21 was transferred to the operating account of the Conferences; the balance was added to the sum invested on their behalf. The amount for the current account forms part of the \$23,108.16 income from investment mentioned above in the first table.

Most of the amount for endowment, reserve, and prize funds was added to the invested balances. The following allocations were made:

Transfer to operating fund for life and emeritus members	\$ 8,810.25
Grants to academies of science	8,585.50

Expenses of Newcomb Cleveland Prize	350.00
Award and expenses of Socio-Psychological Prize	1,350.00
Increase in endowment, reserve, and prize funds	22,356.63

The endowment funds also grew by \$9866.50, through fees of new life members and other contributions.

#### Consolidated Balance Sheet

At the end of 1959, the consolidated balance sheet of the Association, which includes both operating and investment funds, showed the following assets:

Cash on deposit	\$ 203,105.56
Investments at quoted market price (including not only the "investment" account but also operating funds invested in short-term government securities)	1,211,922.00
Land	115,875.00
Building (less depreciation)	699,694.87
Equipment (less depreciation)	65,486.62
Money owed to the Association	104,434.00
Inventory of symposium volumes	58,094.56
Deferred expenses	2,398.95
Total	\$2,461,011.56

These assets were partially offset by the following liabilities:

Prepaid dues and subscriptions for which members and other subscribers had not received <i>Science</i> or other services	\$387,679.67
Unexpended balance of grants from National Science Foundation, Carnegie Corporation, Asia Foundation, and others	196,123.23
Academy grants allocated but not as yet disbursed	6,637.69
Accounts payable to others	92,090.73
Remainder of mortgage on building payable in 6½ years	121,899.49
Retirement reserve	3,219.68
Help for Gordon Research Conferences	41,620.27
Total	\$849,270.76

The difference between assets and liabilities represents the Association's net worth. At the end of 1959, the net worth was distributed as follows:

Endowment funds:	
For research	\$ 216,956.13
For general purposes (used to pay subscription costs for life and emeritus members)	223,259.28
For the Newcomb Cleveland Prize	29,763.91
For the Socio-Psychological Prize	31,212.18
For creating emeritus life memberships	5,371.78

## **Kodak reports on:**

**new dimensional stability in recording film...tinging the stream**

Kodak

**He has always thought  
a pick was the tool  
with which the  
Erie Canal was dug.**



Dr. F. W. Spangler (left) meets R. C. Hilton, senior geophysicist in charge of geophysical data processing for Shell Oil Company, Houston. Purpose of the visit is to familiarize Dr. Spangler directly with the ideal characteristics which Shell desires in a polyester recording film for use in the Reynolds Plotter. Dr. Spangler is an assistant superintendent of Kodak Film Emulsion Division.

He thinks "D Max" is the name of a guy who might have been called "Dave" but wanted a classier handle.

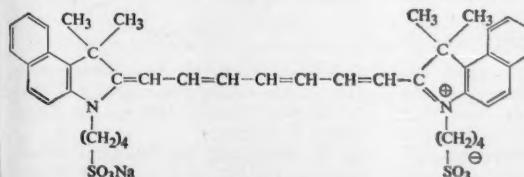
With the switch to thin, rugged Estar Base that eliminates troublesome dimensional change, Fred Spangler had to decide what inherent maximum density to give the **new Kodak Linagraph Recording Film**. Dick Hilton needs more from a film than that it shouldn't be troublesome. He doesn't talk Fred's "D Max" language. He seeks a certain appearance to which his perceptual process best responds in picking a "pick" from the corrected cross-section of the deep geological formation which the Plotter puts on the film. Spangler

## Dye for the heart

We make a dye that has an absorption peak where the absorption curves cross for oxygenated and reduced hemoglobin. The strange consequence of this bit of trivia is that lives are being saved. Bad hearts are rebuilt.

Though the art of heart surgery is hard to teach through advertising columns, we hope some unforeseeable good might come from mentioning the dye to a wider scientific circle than knows it now.

Its molecule was constructed like this:



by an interesting man who admires cats, writes warmly and well of the music of Brahms, and has supervised the synthesis of an average of one new dye a day during the 30-odd years we have enjoyed the good fortune to retain him in our employ.

When a certain distinguished medical investigator asked for a dye that peaks sharply at 8000A in the infrared, our man went to work and produced indocyanine green.

Before these heart men undertake a repair job, they must

learned plenty from him and from others with other instrumentation and other perceptual patterns of translating photographic images into technical intelligence.

*Eastman Kodak Company, Photorecording Methods Division, Rochester 4, N. Y., will be glad to write you a letter answering practical questions about the new Kodak Linagraph Recording Film (Estar Base), such as who sells it and how to handle it, but we see no purpose in spilling a lot more words about it when all you have to do, if you are interested, is get some and see whether it suits you.*

know what's wrong with the way the blood streams. Dyes are sometimes used to trace underground streams of water. Blood is already colored. Moreover its color depends on where it has been last. To add another color at a given point in the circuit, to measure this color automatically at some other point, and to calculate blood volume from the dilution of the color require the heart men to back their incredibly talented fingers with a little optical physics and adult habits of mathematical thought. It was clever to simplify the equations and raise sensitivity by centering dye absorption and photocell response at a wavelength where arterial and venous blood absorb light equally and weakly—cleverer even than the previous choice of Evans Blue, which just *looks* different from blood.

Things happen fast. A quick shot of indocyanine green at safe dilution goes in. A few seconds later the 8000A absorption, as a galvanometer plots it on photorecording paper, changes for a few more seconds. The shape of the plot tells the story to a man who has learned how to figure it out.

No toxic penalties have been noted. The patient does not change color. The dye appears to be rapidly and completely bound to blood albumin. It is quickly taken up by the healthy liver and all excreted in bile. The unhealthy liver takes significantly longer. Therefore there is a prospect of eventually using it to detect unhealthy livers.

Under the trademark "Cardio-Green" our indocyanine green is prepared for medical use and distributed by the pharmaceutical house of Hynson, Westcott & Dunning, Inc., Baltimore 1, Md. If you ask us anything more, we shall just pass your inquiry on to them, so you might as well write direct.

**This is another advertisement where Eastman Kodak Company probes at random for mutual interests and occasionally a little revenue from those whose work has something to do with science.**

Association funds invested in land, building, and equipment	759,157.00
Unallocated reserve	265,967.29
Unrealized appreciation in value of securities	80,053.23
Total	\$1,611,740.80

#### Auditor's Report

C. P. Graham and Company, certified public accountants, audited the 1959 report, as they have the financial reports in past years. The tables presented above differ in form from those included in the auditor's report, and the explanations of sources of income and nature of expenses are usually given in greater detail. In a few instances, items have been reclassified from the auditor's report to provide more meaningful grouping. Except for such rearrangements, there are no differences between the figures presented here and those reported in the audited account, to which was attached a letter ending: "In our opinion the accompanying statements present fairly the financial position of the American Association for the Advancement of Science as at December 31, 1959, and the results of its operations for the year ended on that date, and were prepared in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year, except for the change, which we approve, in recording the inventory of symposium volumes. Respectfully submitted, G. P. Graham and Company, by G. R. Bowers."

DAEL WOLFE

American Association for the Advancement of Science

#### Forthcoming Events

##### August

28-1. American Inst. of Biological Sciences, annual, Stillwater, Okla. (H. T. Cox, AIBS, 2000 P St., NW, Washington 6)

The following 20 meetings are being held in conjunction with the AIBS meeting at Stillwater, Okla.

American Bryological Soc. (G. J. Ikenberry, Dept. of Botany and Plant Pathology, Oklahoma State Univ., Stillwater)

American Fern Soc. (U. T. Waterfall, Dept. of Botany, Oklahoma State Univ., Stillwater)

American Microscopical Soc. (R. W. Jones, Dept. of Zoology, Oklahoma State Univ., Stillwater)

American Soc. for Horticultural Science. (D. G. White, Dept. of Horticulture, Oklahoma State Univ., Stillwater)

American Soc. of Limnology and Oceanography. (T. C. Dorris, Dept. of Zoology, Oklahoma State Univ., Stillwater)

American Soc. of Plant Physiologists. (C. L. Leinweber, Dept. of Botany and Plant Pathology, Oklahoma State Univ., Stillwater)

American Soc. of Plant Taxonomists. (U. T. Waterfall, Dept. of Botany, Oklahoma State Univ., Stillwater)

American Soc. of Zoologists (R. W. Jones, Dept. of Zoology, Oklahoma State Univ., Stillwater)

Biometric Soc. (ENAR). (C. Marshall, Statistics Laboratory, Oklahoma State Univ., Stillwater)

Botanical Soc. of America. (W. W. Hanson, Dept. of Botany and Plant Physiology, Oklahoma State Univ., Stillwater)

Ecological Soc. of America. (A. Stebler, Oklahoma Cooperative Wildlife Research Unit, Oklahoma State Univ., Stillwater)

Genetic Soc. of America. (H. Bruneau, Dept. of Zoology, Oklahoma State Univ., Stillwater)

Mycological Soc. of America. (J. E. Thomas, Dept. of Botany and Plant Pathology, Oklahoma State Univ., Stillwater)

National Assoc. of Biology Teachers. (T. Overmire, 1709 Admiral Rd., Stillwater, Okla.)

Nature Conservancy. (A. Stebler, Oklahoma Cooperative Wildlife Research Unit, Oklahoma State Univ., Stillwater)

Phi Sigma Soc. (D. E. Howell, Dept. of Entomology, Oklahoma State Univ., Stillwater)

Phycological Soc. of America. (I. V. Holt, Dept. of Botany, Oklahoma State Univ., Stillwater)

Society for Industrial Microbiology. (R. C. Allred, Central Research Lab., Continental Oil Co., Ponca City, Okla.)

Society for the Study of Development and Growth. (R. W. Jones, Dept. of Zoology, Oklahoma State Univ., Stillwater)

Society of Protozoologists. (D. W. Twyford, Dept. of Zoology, Oklahoma State Univ., Stillwater)

Tomato Genetics Cooperative. (D. G. White, Dept. of Horticulture, Oklahoma State Univ., Stillwater)

28-1. Association of American Geographers, East Lansing, Mich. (M. F. Burdill, Office of Geography, Dept. of Interior, Washington 25)

28-1. Diseases of the Chest, intern. cong., Vienna, Austria. (M. Kornfeld, 112 E. Chestnut St., Chicago 11, Ill.)

28-2. Combustion, 8th intern. symp., Pasadena, Calif. (Office of Industrial Associates, California Inst. of Technology, Pasadena)

28-2. International Pharmaceutical Federation, Copenhagen, Denmark. (A. W. Tønnesen, Bispebjerg Hospital, Copenhagen, N.V.)

28-2. International Soc. for the Welfare of Cripples, world cong., New York, N.Y. (D. V. Wilson, 701 First Ave., New York)

28-3. Electron Microscopy, European regional conf., Delft, Netherlands. (A. L. Housink, Lab. v. Microbiologie, Julianalaan 67A, Delft)

28-3. Histochemistry and Cytochemistry, 1st intern. cong., Paris, France. (R. Wegmann, Institut d'Histochemistry Medicale, 45, rue des Saints-Pères, Paris 6<sup>e</sup>)

29-31. American Sociological Assoc., New York, N.Y. (D. R. Young, Russell Sage Foundation, 505 Park Ave., New York)

29-31. Clinical Chemists (Canadian and American Societies), annual, Montreal, Canada. (E. Harpur, Montreal Children's Hospital, Montreal)

29-31. Electron Microscope Soc. of America, 18th annual, Milwaukee, Wis. (W. C. Bigelow, Dept. of Chemical and Metallurgical Engineering, Univ. of Michigan, Ann Arbor)

29-31. Metallurgy of Elemental and Compound Semiconductors, Boston, Mass. (E. O. Kirkendall, AIME, 29 W. 39 St., New York 18)

29-31. Water Quality Measurement and Instrumentation, PHS symp., Cincinnati, Ohio. (R. T. Hyde, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26)

29-1. Ballistic Missile and Space Technology, 5th symp., Los Angeles, Calif. (C. T. Morrow, Space Technology Laboratories, P.O. Box 95001, Los Angeles 45)

29-1. Mathematic Assoc. of America, 41st summer, East Lansing, Mich. (H. M. Gehman, Univ. of Buffalo, Buffalo 14, N.Y.)

29-2. Semiconductors, 5th intern. conf., Prague, Czechoslovakia. (M. Matyas, Inst. of Technological Physics, Cukrovarnická 10, Prague 5)

29-3. American Mathematical Soc., natl. summer, East Lansing, Mich. (Miss L. Charron, AMS, Administrative Services, 190 Hope St., Providence, R.I.)

29-3. International Cong. on Low Temperature Physics, Toronto, Canada. (IUPAP, 3, boulevard Pasteur, Paris 15<sup>e</sup>, France)

29-3. International Conf. on Nuclear Structure, Kingston, Ontario, Canada. (L. G. Elliott, Atomic Energy of Canada, Chalk River, Ontario, Canada)

29-3. Nuclear Structure, annual intern. conf., Kingston, Ontario, Canada. (L. G. Elliott, Atomic Energy of Canada Ltd., Chalk River, Ontario)

29-16. World Forestry Conf., 5th, Seattle, Wash. (I. T. Haig, 5th WFC, Dept. of State, Washington 25)

31-6. International cong. de Sociologie, 19th, Mexico City, Mexico. (C. C. Zimmerman, 200 Emerson Hall, Harvard Univ., Cambridge 38, Mass.)

31-7. Applied Mechanics, 10th intern. cong., Stresa, Italy. (F. Rolla, Consiglio Nazionale delle Ricerche, Ufficio Relazioni Internazionali, Piazza delle Scienze 7, Rome, Italy)

31-7. British Assoc. for the Advancement of Science, annual, Cardiff, South Wales. (Secretary, BAAS, 18 Adam St., Adelphi, London, W.C.2, England)

#### September

1-3. Nephrology, 1st intern. cong., Geneva and Evian, Switzerland. (G. Richet, Hôpital Necker, 149 rue de Sèvres, Paris 15<sup>e</sup>, France)

1-7. American Psychological Assoc., Chicago, Ill. (L. F. Carter, 249 Mantua Rd., Pacific Palisades, Calif.)

1-7. Nutrition, 5th intern. cong., Washington, D.C. (M. O. Lee, 9650 Wisconsin Ave., Washington 14)

2-5. Astronomical League, Haverford, Pa. (R. Dakin, 720 Pittsford-Victor Rd., Pittsford, N.Y.)

3-10. International Cong. of Preventive Medicine and Social Hygiene, 8th, Bad Aussee, Austria. (A. Rottmann, Liechtensteinstrasse 32/4, Vienna 9, Austria)

4-9. Cell Biology, 10th intern. cong., Paris, France. (M. Chèvremont, Institut

# GET YOUR ADVANCE COPY of the General Program of the AAAS New York Meeting by first class mail—early in December

The General Program of the 127th Meeting of the AAAS in New York, 26–31 December 1960, will be available to you, at cost, within the first week in December—whether you can attend the Meeting or not.

## Program Content

1. The two-session AAAS General Symposium, "Moving Frontiers of Science V"—Speakers: Edward Anders, H. W. Magoun, George Wald, and H. H. Goldstone; Thomas Park, presiding.
2. The "Challenge to Science" evening with Sir Charles P. Snow, Theodore M. Hesburgh, and W. O. Baker; Warren Weaver, presiding.
3. On "AAAS Day," the three broad, interdisciplinary symposia—Plasma: Fourth State of Matter; Life under Extreme Conditions; and Urban Renewal and Development, arranged by AAAS Sections jointly.
4. The Special Sessions: AAAS Presidential Address and Reception; Joint Address of Sigma Xi and Phi Beta Kappa by Polykarp Kusch; the Tau Beta Pi Address; National Geographic Society Illustrated Lecture; and the first George Sarton Memorial Address by René Dubos.
5. The programs of all 18 AAAS Sections (specialized symposia and contributed papers).
6. The programs of the national meetings of the American Astronomical Society, American Nature Study Society, American Society of Zoologists, History of Science Society, National Association of Biology Teachers, Scientific Research Society of America, Sigma Delta Epsilon, Society for General Systems Research, Society for the Study of Evolution, Society for the History of Technology, Society of Systematic Zoology, and the Society of the Sigma Xi.
7. The multi-sessioned special programs of the American Association of Clinical Chemists, American Astronautical Society, American Geophysical Union, American Physiological Society, American Psychiatric Association, American Society of Criminology, Association of American Geographers, Ecological Society of America, Mycological Society of America, National Science Teachers Association, New York Academy of Sciences—and still others, a total of some 90 participating organizations.
8. The four-session program of the Conference on Scientific Communication: The Sciences in Communist China, cosponsored by the AAAS, NSF, and ten societies.
9. The sessions of the Academy Conference, the Conference on Scientific Manpower, and the conference of the American Council on Women in Science.
10. The sessions of the AAAS Cooperative Committee on the Teaching of Science and Mathematics, and of the AAAS Committee on Science in the Promotion of Human Welfare.
11. Titles of the latest foreign and domestic scientific films to be shown in the AAAS Science Theatre.
12. Exhibitors in the 1960 Annual Exposition of Science and Industry—103 booths—and descriptions of their exhibits.

## Advance Registration

Advance registration has these decided advantages: (1) You avoid delay at the Registration Center upon arrival; (2) You receive the General Program in ample time to decide, unhurriedly, which events and sessions you particularly wish to attend; (3) Your name is posted in the Visible Directory as the Meeting opens.

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d'Histologie, 20, rue de Pitteurs, Liege, Belgium)

4-9. Laurentian Hormone Conf., Mont Tremblant, Quebec, Canada. (Arrangements Committee, Laurentian Hormone Conf., 222 Maple St., Shrewsbury, Mass.)

4-10. International Soc. of Orthopaedic Surgery and Traumatology, 8th cong., New York, N.Y. (A. Bailleux, Société de Chirurgie Orthopédique et de Traumatologie, 34, rue Montoyer, Brussels, Belgium)

4-10. World Cong. of Anaesthesiologists, Toronto, Canada. (R. A. Gordon, 516 Medical Arts Bldg., Toronto 5)

4-14. International Societies of Hematology and Blood Transfusion, 8th cong., Tokyo, Japan. (S. Murakami, Blood Transfusion Laboratory, Japanese Red Cross Soc., Shibuya, Tokyo)

5-7. Society for Biological Rhythm, 7th conf., Siena, Italy. (A. Sollberger, Dept. of Anatomy, Caroline Inst., Stockholm 60)

5-8. Legal and Administrative Problems of Protection in the Field of the Peaceful Applications of Atomic Energy, intern. symp., Brussels, Belgium. (Communauté Européenne de l'Energie Atomique, rue Belliard 51-53, Brussels)

5-9. Chemical Engineering (Czechoslovak Chemical Soc.), Prague, Czechoslovakia. (Technická 1905, Prague-Dejvice, Czechoslovakia)

5-10. Microbiology of Non-Alcoholic Beverages, 5th intern. symp., Evian, France. (D. A. A. Mossell, Intern. Assoc. of Microbiological Societies, c/o Central Inst. for Nutrition Research, Catherinensingel 61, Utrecht, Netherlands)

5-9. Medium and Small Power Reactors, conf., Vienna, Austria. (International Atomic Energy Agency, 11 Kärntner Ring, Vienna 1)

5-10. Operational Research, 2nd intern. conf., Aix-en-Provence, France. (International Federation of Operational Research Societies, 11 Park Lane, London, W.1)

5-12. International Soc. of Bioclimatology and Biometeorology, 2nd cong., London, England. (E. M. Glaser, Dept. of Physiology, London Hospital Medical College, Turner St., London, E.1)

5-15. International Scientific Radio Union, London, England. (R. L. Smith-Rose, Radio Research Station, DSIR, Ditton Park, Slough, Bucks, England)

5-17. Photogrammetry, 9th intern. cong., London, England. (J. B. P. Angwin, Intern. Soc. for Photogrammetry, 18 Cavendish Sq., London, W.1)

6-7. Some Fundamental Aspects of Atomic Reactions, symp., Montreal, Canada. (J. C. Polanyi, Dept. of Chemistry, Univ. of Toronto, Toronto 5, Canada)

6-8. Nuclear and Radio-Chemistry, symp., Chalk River, Ontario, Canada. (R. H. Betts, Atomic Energy of Canada Ltd., Chalk River, Ontario)

6-8. Society of General Physiologists, annual, Woods Hole, Mass. (J. W. Green, Rutgers Univ., New Brunswick, N.J.)

6-17. Use of Radioactive Isotopes in the Physical Sciences and Industry, conf., Copenhagen, Denmark. (International Atomic Energy Agency, 11 Kärntner Ring, Vienna 1, Austria)

7-8. Canadian Textile Seminar, 7th, Kingston, Ontario. (J. M. Merriman, Textile Technical Federation of Canada, 223 Victoria Ave., Westmount, P.Q.)

(See issue of 29 July for comprehensive list)

## New Products

The information reported here is obtained from manufacturers and from other sources considered to be reliable. Neither Science nor the writer assumes responsibility for the accuracy of the information. All inquiries concerning items listed should be addressed to the manufacturer. Include the department number in your inquiry.

■ TRACKING ACCURACY CONTROL ACCESSORY for the manufacturer's infrared spectrophotometer provides automatic speed control and automatic period control. The speed control comes into operation  $1/2$  sec after the appearance of a photometric signal and slows the scanning to a speed proportional to the absorption down to a minimum  $1/10$  that of normal scanning speed. The period control adjusts the period in response to photometric signals beyond preselected limits, thus producing a quiet curve in the transparent regions while preserving short-period response in the high-absorption bands. (Beckman Instruments, Dept. Sci678, 2500 Fullerton Rd., Fullerton, Calif.)

■ PROJECTOR PRINTER is capable of producing prints up to 34 by 48 in. An electrostatic process is used to provide a finished print in 40 sec. The semiconductor coated paper is electrostatically charged by means of a corona bar that travels back and forth across the paper. Exposure to light discharges the illuminated areas following which toning powders are attracted to the image areas. The print is fixed by heat. (Keuffel and Esser Co., Dept. Sci681, Hoboken, N.J.)

■ VACUUM GAGE series comprises four ionization gage models, two with range from  $10^{-3}$  to  $10^{-9}$  mm-Hg and two with range  $10^{-8}$  to  $10^{-10}$  mm-Hg. The gages employ electrometer-type amplifiers with negative feedback. Zero drift is said to be less than  $\pm 2$  percent in 24 hours. A protective circuit operates a relay that opens the filament circuit when pressure rises above a present value adjustable from 20 to 150 percent of full scale. (F. J. Stokes Corp., Dept. Sci684, 5500 Tabor Rd., Philadelphia, Pa.)

■ PHOTOGRAPHIC PROCESSOR for 35-mm film measures  $3\frac{1}{2}$  by  $14\frac{1}{2}$  by  $36\frac{1}{2}$  in. and weighs 120 lb without solutions or film. Operation is completely automatic and loading can be performed in daylight. All tanks are stainless steel. A thermostatic control provides controlled temperatures adjustable between  $68^\circ$  and  $150^\circ F$  constant to  $\pm 1^\circ F$ . Processing rate is continuously variable from 0.5 to 6 ft/min. Up to 400 ft of film may be processed without replenishing solutions. (Fairchild Camera and Instruments Corp., Dept. Sci685, 300 Robbins Lane, Syosset, N.Y.)

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■ VOLTAGE MONITORING SYSTEM contains a switch-type magnetic amplifier for each of eight sensing channels, a d-c voltage reference unit and a resistor assembly. Indication is provided by the instrument when a deviation from nominal voltage is greater than a preset value; the indication is held until the voltage being sensed has become less than that value. Operating power is 120 volts, 400 cy/sec. (Magnetic Controls Co., Dept. Sci687, 405 Cambridge St., Minneapolis 26, Minn.)

■ ALARM SCANNER for millivolt and higher-level signals is said to be capable of scanning from 1000 to 20,000 points per second with provision for adjustment of setting and tolerance on each input. Signals are accepted from thermocouples, strain gages, or resistances. Minimum common-mode rejection at 60 cy/sec is 130 db. Input for each point consists of a winding on a magnetic amplifier. Scanning is effected by switching carrier power to each amplifier in turn by means of a solid-state matrix. Visible and audible alarms can be provided with alarm-point identification and memory. (San Diego Scientific Corp., Dept. Sci689, 3434 Midway Drive, San Diego 10, Calif.)

■ CAPACITANCE BRIDGE measures from 0.002 to 1,000 pf with accuracy said to be  $\pm 0.2$  percent. Operation of the completely self-contained instrument is based on a transformer ratio-arm bridge operating at 1 key/sec. The technique requires only one capacitive and resistive standard. (Marconi Instruments, Dept. Sci686, 111 Cedar Lane, Englewood, N.J.)

■ FRACTION COLLECTOR transfers fractions from the carrier gas of a gas chromatograph directly into an ultra-micro cavity type infrared absorption cell. The fraction collector consists of a glass condenser, the bottom end of which opens into the neck of the infrared cell. In operation the lower portion of the collector is placed in a coolant such as solid CO<sub>2</sub> and acetone. The unit is designed to fit directly into standard 15/16 in. centrifuge tubes to permit small samples to be moved from the condenser to the cell. (Connecticut Instrument Corp., Dept. Sci691, Wilton, Conn.)

■ MICROMINIATURE ELECTRIC LIGHT BULB is an incandescent lamp 0.015 in. in diameter and 0.062 in. long. The bulb is furnished with axial platinum leads 0.003 in. in diameter. Operation is on 1.5 volts with current of 15 ma. (Kay Electric Co., Dept. Sci680, 14 Maple Ave., Pine Brook, N.J.)

JOSHUA STERN

National Bureau of Standards,  
Washington, D.C.

## Letters

### "Of Mice and Mangun"

About two years ago I set up a small laboratory and animal husbandry room in my barn in Mendham Township, New Jersey. It is back from a dirt road in a farming and residential area on an 18-acre farm. On a complaint from one neighbor, I was found guilty of "hiring employees and raising animals for the purpose of doing research." The area is also zoned to permit builders, contractors, physicians, surgeons, engineers, carpenters, hairdressers, and plumbers to conduct their offices and usual accessory activities.

I applied for a variance following the limited interpretation of the zoning ordinance, and it was rejected despite the fact that only one of the 12 neighbors within 500 feet of my property lines was opposed, and despite the fact that a petition for a variance or a change in the wording of the ordinance was signed by 150 township property owners while an opposing petition received only eight signatures.

At this point I decided to move elsewhere, and soon after I announced my decision, children began calling for free mice. Word spread, and a growing stream of children appeared. On Friday, 13 May, a reporter called. The conversation was quite short and in essence went as follows:

*Reporter* (convulsed with laughter): Dr. Mangun, is it true you are giving away white mice?

*G.H.M.*: Yes, about 20 kids have come around and picked up a couple of hundred mice.

*Reporter*: And is it true you are doing this for revenge against the township because they forced you to close your lab?

*G.H.M.*: Not at all. I've given away lots of mice before and helped the kids set up feeding and growth experiments in the hope of stimulating their interest in biology, science, and medicine. Some of the children have spent many hours in my laboratory helping to care for the animals and watching or assisting with experiments. I did once jokingly remark that it would be a jolly sight as I drove my trail herd down main street on my way West, and just maybe a few of the critters might get lost.

*Reporter*: Then is it definitely not true that you are doing this for revenge?

*G.H.M.*: Of course not! [Then, after contemplating the situation in this new light] My only "revenge" will be to turn their children into biologists so they will amount to more than this generation.

*Reporter*: Very good, Dr. Mangun. Goodbye.

The resulting story went critical the

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Spackman, Smith,  
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following morning, and shortly thereafter my barn went intensely paramagnetic (kiddophilic and mammaphobic). It took me 10 days to crawl out from under the crowd. Meanwhile the press forged two versions of the story—the humorous side captioned by such headlines "Pied Piper Sends 'em Back," "Science at Work," "Researcher Avenged with Mouse-ola," "One Jolly Hickory Dickory Doc," "Of Mice and Mangun," "Doc Makes Town Crawl," and "Mangun, Merry Mouse Man of Mendham." No one thought to call me the Pied Pipetter. Except for the original story in the Newark News, all versions edited out the *only* in my original statement and used the statement out of context.

Some papers ignored the tongue-in-cheek vein of the original story and quoted me as saying I was taking revenge against the township. I have never made any such statement. Retribution is proceeding sanely by due democratic process.

I have learned the hard way that research is looked upon by some as "just a way to make a buck." In part this may be due to the confusion existing in the mind of the public as to the distinction between basic scientific research, applied research and technology, and manufacturing laboratories. Fear and distrust of the scientist were also abundantly evident in the attitude of a few of the objectors, who had some almost amusing Frankensteinian qualms.

Well, it's been fun and most educational to operate a laboratory on an isolated farm. At the same time I have obtained a lot of very interesting data on enzymes and analgesics. However, I would recommend that anyone setting up a private research laboratory seriously consider inventing a new name for it—for instance, a "knowledge studio."

GEORGE H. MANGUN

*Schoolhouse Lane,  
Morristown, New Jersey*

### The Chinese Chestnut

I noted with interest the photograph of Chinese chestnut nuts, bur, and leaves on the cover of the 25 March issue of *Science* [131 (1960)].

I have a slight criticism to make about your statement about the Chinese chestnut. You say that widespread planting of the Chinese chestnut "is bringing back the chestnut to the American scene." It is true that we again have nut-producing trees of the chestnut growing in this country, but the Chinese chestnut is very different in its habit of growth from the American chestnut, and it will never replace the

native tree. The American chestnut was one of our greatest timber species. It was a tall, stout-growing tree whose wood found many uses, particularly for telephone poles. The Chinese chestnut is almost a shrub in comparison. It is a small-growing tree of unimpressive potentialities as a timber tree. It will never find its way into our native forests. Its best use is as an orchard or lawn tree.

Incidentally, the poetic phrase "Under the spreading chestnut tree" referred to the horse chestnut, a beautiful tree which fortunately is still with us.

ROBERT RODALE

*"Organic Gardening and Farming,"  
Emmaus, Pennsylvania*

Robert Rodale's statement that the Chinese chestnut will never replace the American species as a timber tree is correct. In our description of the cover illustration we did not have the space to point out that "bringing back the chestnut to the American scene" referred to the production of nuts and not to timber. However, Rodale is somewhat misleading when he says the Chinese chestnut is "almost a shrub" in comparison with the American. We know of Chinese chestnut trees that have a trunk more than 2 feet in diameter and are more than 50 feet tall. It is true that the tree does not generally have a straight central trunk, and the top is usually spreading and rounded.

J. W. MCKAY

F. H. BERRY

*Crops Research Division,  
U.S. Agricultural Research Service,  
Beltsville, Maryland*

### More on Stochastic Models

This note is concerned with a criticism of some of the remarks made by N. E. Manos in his recent letter [*Science* 131, 1400 (1960)]. Although Manos did not give an indication of what he meant by the much abused term *deterministic*, I assume that he meant it in the sense of entailing a necessary logical relation between the members of a class of prescribed characteristics. The latter is in keeping with E. Nagel's definition of *deterministic* [*Phil. and Phenomenolog. Research* 20, 291 (1960)].

By way of equilibrating Manos' statement to the effect that many investigators in the physical sciences reject any research which is not deterministic, I wish to point out that much of contemporary philosophy, physics, and electrical engineering is "process-minded"; this includes stochastic processes. Surely, quantum mechanics with its expanding domains of intellectual inquiry and

its materialistic yield of the transistor cannot be said to be unrealistic. The statistical model pulled together enough relevant facts long enough so that a human mind could make a significant prediction. The same may be said for the model of communications called "information theory." Further fuel may be added to the fire when we consider D. Bohm's remark, "we may say that the processes taking place in nature may have been found to satisfy laws that are more general than those of causality. For these processes may also satisfy laws of chance. . . ." [*Causality and Chance in Modern Physics* (Van Nostrand, Princeton, N.J., 1957), p. 3]. Probably it is accurate to say that an exclusive use of only determinism or only statistics will make understanding of a scientific endeavor more difficult. Perhaps this is a useful principle of dualism in the interpretation of physics.

Finally, as to Manos' comment, "if the world is basically deterministic," I am of the opinion that we should view the world with any model which is capable of exercising our brains, with some resultant esthetic pleasure, and which shows signs of allowing us to reap material rewards.

A. A. MULLIN

*Electrical Engineering Department,  
University of Illinois, Urbana*

### Terrestrial Ostracodes

Ostracodes were recently described at a scientific convention, to a wife who was not a biologist, as "microscopic clams each with a shrimp inside." For almost 200 years they have been known as living and as fossil aquatic bivalved crustaceans that inhabit fresh, brackish, and marine waters.

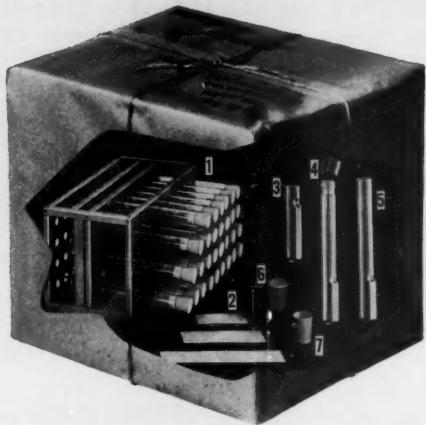
Menzel [*Arch. Hydrobiol. Planktonk.* 11, 478 (1916)] described ostracodes from wet moss, but the first known terrestrial species, *Mesocypris terrestris* Harding, 1953 [*Ann. Natal Museum* 12, 359 (1953)] was described from ordinary damp forest humus obtained at an altitude of 500 feet in the Knysna forest, South Africa. The discovery of these terrestrial forms was incidental to the processing of soil samples in a Berlese funnel in order to collect myriapods and small arachnids. In a later paper, Harding [*Bull. Natl. Inst. Sci. India No. 7* (1955), pp. 104-106] suggested that the water in the form of vapor in a humid atmosphere is sufficient to maintain the terrestrial ostracodes.

Chapman [*Nature (Paris)*, No. 4706 (1960), p. 121] recorded the presence of ostracodes of the same genus in New Zealand from six localities that range in elevation from 800 to 3200 feet and from a variety of environment, such as

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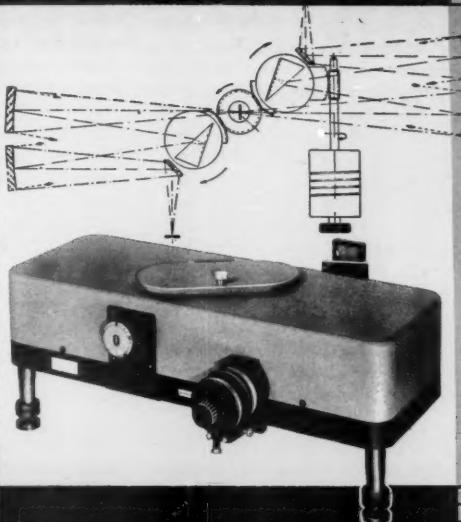


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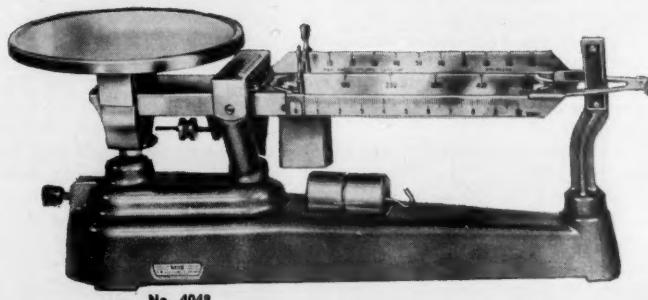
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ordinary damp litter from podocarp-broadleaf forest, subalpine forest, and beech litter. She reported that the animals can be extracted alive by slowly drying out litter in a Berlese funnel, with a water-jacket maintained at a temperature of 40°C and with the end leading into water. They can be kept in the laboratory on moist filter paper and fed on humus. The ostracodes have survived total immersion in water in the laboratory for at least a week and can withstand drying out by closing the valves. The length of the ostracodes is recorded as from 0.56 to 1.04 mm.

There is a possibility that terrestrial ostracodes may be present also in the Northern Hemisphere. A record of terrestrial ostracodes in North America would be of interest to both zoologists and geologists. Because the presence of fossil ostracodes has hitherto been taken as evidence of an aquatic environment, data on the frequency, distribution, and ecology of terrestrial forms would have some bearing on paleoecological interpretations.

Researchers who examine extracts from Berlese funnels are asked to watch for possible ostracodes. I will be interested to hear of any terrestrial ostracodes found.

I. G. SOHN

*U.S. Geological Survey,  
Washington, D.C.*

## Oxygen Diffusion

Scholander has recently described an experiment which demonstrated that the presence of hemoglobin in a wet membrane increased the diffusion rate of oxygen as much as eightfold over the rate through the same membrane when it contained only water [Science 131, 585 (1960)]. Actually, Scholander measured only the change in ratio of the diffusion rates of oxygen and nitrogen when hemoglobin was added to water. He interpreted his data as evidence for an increased diffusion rate resulting from the presence of hemoglobin.

Although Scholander's experimental data are not subject to argument, there is some question concerning his interpretation of these data. He interprets his data to mean that there is an increase in oxygen diffusion rate through a liquid containing hemoglobin compared with the same liquid free of hemoglobin. He then proceeds to develop a hypothesis to explain this increase in oxygen transport.

In his experiment Scholander measured the resistance to diffusional flow through three resistances in series. At the upper surface there was an air-liquid

interface; in the filter paper there was liquid; at the bottom surface there was a liquid-water vapor interface. The experiment showed that the sum of the three resistances decreased for oxygen diffusion (compared with nitrogen) when hemoglobin was added to the liquid in the filter paper. The experiment does not permit one to say that the oxygen-nitrogen diffusion ratio has increased in the liquid. It may well be that the increase is at one of the interfaces. The problem of diffusion through a liquid-gas interface is not easily treated. A detailed description of the difficulties is given by R. W. Schrage in *A Theoretical Study of Interface Mass Transfer* (Columbia University Press, New York, 1953).

A modification of Scholander's procedure would permit measurement of the diffusional resistance in the membrane alone. This could be done by filling the upper chamber with distilled water saturated with oxygen and nitrogen at a given pressure. The lower chamber would be filled with deaerated distilled water. In this system there would be no phase interface. Samples of the water in the lower chamber could be analyzed for oxygen and nitrogen content as a function of time. If the concentrations in the upper and lower chambers did not change much, then it would be evident that the boundary conditions are fairly simple, and the diffusion coefficient of the membrane and its liquid could be calculated without trouble. If the results of this experiment agreed with previous results, then indeed there would be evidence of a change in the diffusional resistance of water to oxygen when hemoglobin is added. It is equally likely, however, that the diffusional resistance at the liquid-air or liquid-vacuum interface would be changed.

If the hemoglobin tended to diffuse away from the filter paper, the filter-paper unit could perhaps be made in the form of a sandwich in which only the center paper was impregnated with hemoglobin.

To examine the changes at the interfaces, two additional experiments could be performed. In the first, the upper chamber would be filled with water containing oxygen and nitrogen in solution. The lower chamber would contain an inert gas, such as helium or argon, at a pressure sufficient to prevent bulk flow of the water from the upper chamber. By this experiment one can find changes in the diffusional flow resistance at the lower interface. In second experiment, the lower chamber would be filled with deaerated distilled water while the upper chamber would contain oxygen and nitrogen in the gas phase.

The experiments outlined above are

all of the steady-state type. It may be interesting to compare the steady-state diffusion coefficients with the coefficients obtained from nonsteady-state measurements. Scholander's apparatus could be used to do a "time-lag" measurement described by Barrer [J. Phys. Chem. 57, 35 (1953)], from which the diffusion coefficient can be calculated. Ideally, the steady-state and nonsteady-state diffusion coefficients are the same. Differences between the coefficients often shed light on the diffusion mechanism.

In the experiments I have outlined above, it may be necessary to analyze for oxygen and nitrogen directly. I believe this could be done by gas chromatography.

IRVING FATT

*Department of Mineral Technology,  
University of California, Berkeley*

I agree that it would be of great interest to devise an experiment which would avoid the complication of possible interphase effects, and in fact a great deal of thought was given to this problem. Unfortunately, hemoglobin molecules diffuse too fast through a membrane to make promising a system such as that proposed by Fatt, and experiments on intact red cells seemed to be the nearest practicable approach. When smeared as a layer on the under side of the finest grade Millipore membrane, this layer showed the same enhanced oxygen transport as a hemoglobin solution, and it was assumed that the entrance into and exit from the cells took place through a hemoglobin-free interphase—that is, through the cell membrane plus whatever saline solution covered the cells.

Even if we were to assume that hemoglobin molecules in solution constitute part of the interphase, it would seem difficult to account quantitatively for the observed enhancement of oxygen transport. At a low pressure this may exceed diffusion by a factor of 8, and because we are dealing with a steady-state transport, each layer of the membrane transmits the same amount of oxygen. If we were to treat the system as diffusive flow through three resistances in series, as suggested by Fatt, we might, for the sake of argument, consider a surface layer of 1-micron thickness to have zero resistance. This would still leave 148 microns of solution to be traversed by diffusion, and it would seem that a specific interphase effect, if indeed there is such an effect, could hardly give enhancement of more than a few percent.

P. F. SCHOLANDER  
*Scripps Institution of Oceanography,  
University of California, La Jolla*

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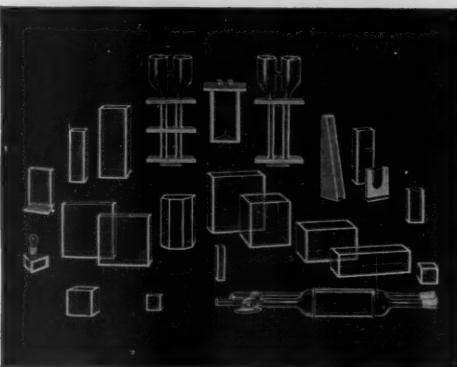
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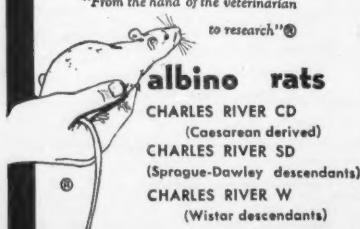
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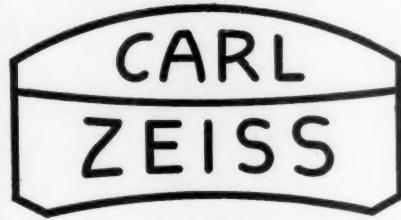
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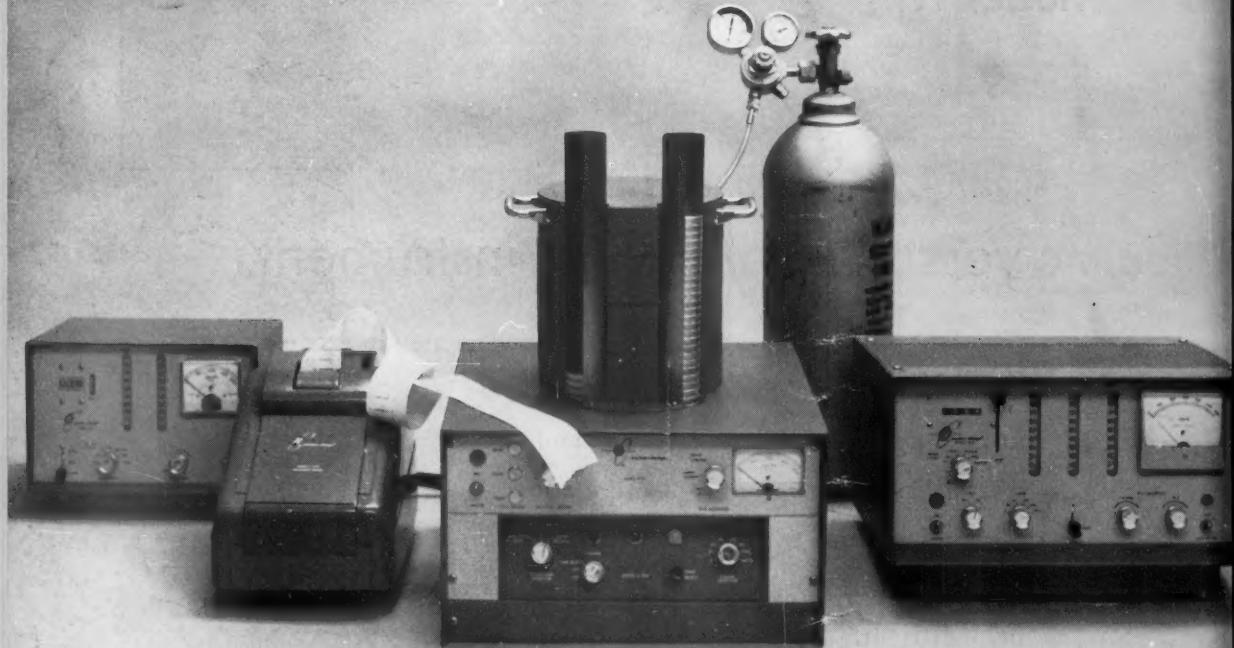
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Low level C-14, P-32, and Sr-90 samples, previously unmeasurable with automatic equipment, can be counted with high precision in Nuclear-Chicago's new Low Background Automatic Sample Changer. Unwanted interfering background has been reduced to only 2 counts per minute by extensive shielding and a unique "guard" which eliminates cosmic ray counts. High sensitivity is achieved by use of a new "Micromil"® window gas flow detector.

The low background permits a substantial cut in the amount of labelled reagent required in tracer work and greatly reduces measurement time. The entire system can be left unattended and printed data collected when convenient. And—if you already have a Nuclear-Chicago Automatic Sampler Changer, you can convert it at modest cost into the new Low Background Changer. For full information, please ask us to send our Bulletin C-115.



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